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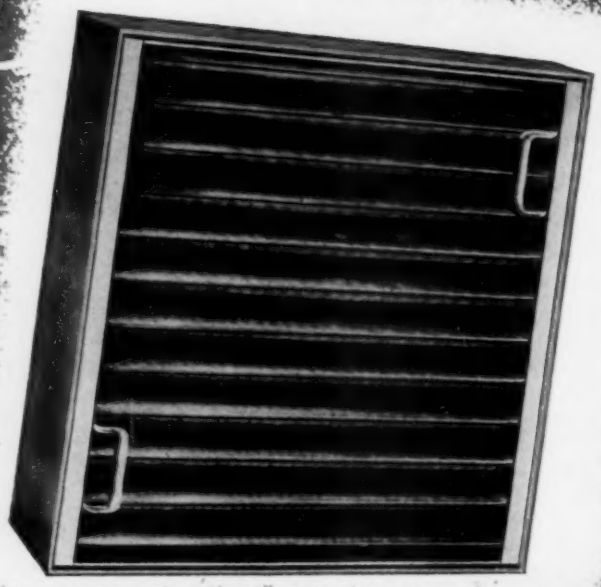

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THE EDITOR'S PAGES

PRODUCERS' COUNCIL FORECASTS BUILDING VOLUME

Expenditures for new construction in 1949 are expected to decline only slightly as compared with 1948, owing to an anticipated increase of 22 percent in publicly financed projects, according to a revised forecast issued by the Producers' Council, national organization of building products manufacturers.

"The value of privately financed construction, on the other hand, is estimated at about 9 percent less than last year," Charles M. Mortensen, the council's executive secretary, stated.

"The total value of new construction is forecast at $18.4 billion, of which 72 percent would be privately financed.

"Every major category of private building is expected to decline, except warehouse, office, utility, and institutional construction. The estimates show a drop of 17 percent in stores, restaurants, and garages. The increase in utility expenditures is attributed mainly to increased construction by power and light companies.

"Increases are anticipated in every important type of public construction, except military and naval. The major gain in dollars is expected in school construction where an increase of 50 percent is forecast. Highway construction is estimated at $1.7 billion, an increase of 6 percent over last year, and sewer and water construction is expected to rise 20 percent.

"Although the total forecast for the year is lower in dollars, an actual gain in the amount of physical construction is anticipated, because building costs during 1949 probably will be somewhat lower than in the preceding year."

"QUOTE"

"Many years ago, a sailor in the antipodes sent to the Royal Society in London an account of a broken leg cure. He had fallen from a mast and fractured his right leg. He asserted that, lacking more effective means, the fractured limb had been placed in splints and given two treatments of tar and oakum. He averred that after two days the limb was whole again and he could walk as well as before.

"This occasioned excitement among scientists and led to exchange of correspondence. No one had suspected tar and oakum of possessing such curative properties. Yet the sailor produced affidavits of witnesses to the truthfulness of his story.

"The mystery was finally solved by the sailor who added a postscript to a later letter stating that the limb in question was a wooden leg.

* * *

"Any respectable independent laboratory endeavors to couch reports of its findings in such a manner as to minimize misleading interpretation. Most clients of ETL, being intent upon good quality, have no desire to misinterpret. But because there is an occasional maverick client more intent upon publicity than upon good quality, it is necessary to safeguard reports so that their true significance shall be apparent."—*from the ETL M-ode, issued by Electrical Testing Laboratories, Inc.*

AIR POLLUTION A MAJOR INTEREST OF STOKER GROUP

The 32nd annual meeting of the Stoker Manufacturers Association, national organization of manufacturers of automatic coal burning equipment, held at French Lick, Ind., was attended by 100 officials and representatives of prominent stoker manufacturing, supply, and allied firms. The convention discussions featured some of the vexing and major problems faced by business enterprises under current conditions with special attention paid to ways and means of strengthening and adding to "sales power" in the stoker industry.

In reporting to the members on the activities of the association during the past year, President Claude A. Potts stated that smoke abatement and air pollution activities constitute one of the major phases in which the stoker industry can contribute to the benefit of the public, and that the many cities which have adopted or are now in the process of establishing new air pollution ordinances make it imperative that stoker engineers and distributors work closely in efforts to help clean up the atmosphere in cities all over the country.

The fuels situation came in for considerable discussion, with the stoker sales executives in agreement that plentiful supplies of gas and oil together with declining fuel oil prices and aggressive merchandising efforts on the part of gas utilities and equipment manufacturers spell keen competition between the manufacturers and purveyors of equipment and all fuels. The American public, it was concluded, will be the net beneficiary of these combined efforts to supply more and more buildings with automatic heat.

Association officers stressed the importance of the commercial and industrial markets for stokers resulting from the huge private and public building and construction activities.

Mr. Potts, vice president, U. S. Machine Corp., was re-elected president and chairman of the board of the SMA for the ensuing year. C. T. Burg, vice president in charge of sales, Iron Fireman Mfg. Co., was elected vice president, and C. P. Meredith, executive vice president, Steel Products Engineering Co., was re-elected secretary-treasurer. Marc G. Bluth was re-appointed executive secretary.

LOWER COSTS EMPHASIZED IN IBR RESEARCH PROGRAM

How to reduce the cost of hot water and steam heating installations will be one of the primary objectives of the IBR research program at the University of Illinois during 1949 and 1950.

This decision was reached at the semi-annual meeting of the Institute of Boiler and Radiator Manufacturers earlier this year. The meeting was attended by 125 members representing manufacturers in the United States and Canada and by associate members who make equipment closely identified with the hot water and steam heating industries.

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In authorizing the continuation of the research program at the university for another year starting July 1, plans were approved for using both the research home and the laboratories of the university for trial installations of low cost hot water and steam heating systems. These installations will involve radical reductions in piping and pipe sizes.

While there has already been considerable attention given to this problem in the research program, and while the five IBR installation guides now available reflect the trend toward lower installation costs, members of the institute felt that this problem should be given top billing.

Other subjects discussed during the three-day session included the institute's consumer advertising program, the field training program, short courses, and the distribution of the installation guides.

It was reported at the meeting that copies of the two new guides were being sent to members of the trade. These are One Pipe Forced Circulation Hot Water Heating Systems, Guide No. 100, and Baseboard Heating Systems, Guide No. 5. No. 100 covers one pipe forced circulation hot water heating systems up to 1½ in. mains, both iron pipe and copper tube, and No. 5 covers all types of baseboards.

STORE MODERNIZATION PAYS OFF

Retailers representing 18,000 stores all over the country agreed, with only ½ of 1 percent dissenting, that store modernization has paid off since the war with gratifying results, according to John W. H. Evans, president of the Store Modernization Institute and managing director of the store modernization shows, in the results of a questionnaire sent to all retail store executives who had attended the two store modernization shows previous to this year's. The show is held each June at Grand Central Palace, New York City.

Chain stores, as usual, retained their lead in this activity, with some individual chains spending as much as $15 million, with an average expenditure of over $1 million, a figure that errs on the low side since many of the largest spenders declined for policy reasons to answer the question. Independents (mostly department stores) followed with an average of $69,000 spent on a wide range of equipment, from complete new store fronts, air conditioning, and moving stairways, to painting and carpeting.

Chain stores, 80 percent of which indicated that they had modernized since the war, maintained a large lead also in the installation of more extensive improvements, with over twice as many chains as independents installing air conditioning, drinking fountains, eating facilities, store fronts, moving stairways, and elevators.

LEAK DETECTOR TESTS RADIANT JOB

To insure a leakproof condition in a radiant heating system being installed in Schenectady, N. Y., William E. Herrmann, engineer in General Electric's special products division, tested the system with a leak detector. This electronic instrument is extremely sensitive to halogens—chlorine, fluorine, bromine, and iodine—and can detect leaks of these gases from openings so small as to release only "one ounce a century."

To make the test, he first introduced a gaseous halogen compound ("Freon") into the 1800 ft of ½ in. copper tubing. Then John S. Hickey, one of the men who participated in the development of the detector, passed the tip of the instrument's pistol-shaped pickup through the air surrounding the tubing. If any trace of the halogen was present, the leak detector indicated the fact on a dial.

According to Mr. Herrmann, about 100 joints in the tubing were checked in this manner in less than 2 hr. Three leaks, undetected by two different previous tests, were spotted immediately. If the leaks had not been detected and repaired before the plastering was done, later repair would have entailed considerable difficulty and expense.

Leak detector tests radiant heating coils

ENGINEERING ROSTER BEING COMPILED

The government needs highly qualified engineers and scientists for work in the fields of their greatest competence, and a new file in Washington is being accumulated to contain 100,000 questionnaires now on the way to professional engineers and scientists.

As a source file of key engineering personnel, this roster will aid in solving a variety of national technical personnel problems. National resources of technical personnel can be ascertained. In emergency the file can be used to minimize disturbance to the national economy.

The scientific personnel branch of the Office of Naval Research (ONR) has been assigned by the Secretary of Defense to be the referring office for scientific uniformed and civilian employees. The Office of Naval Research serves the national military establishment and has liaison with all scientific agencies of the government.

1948 A "BANNER SAFETY YEAR"

Industry had a banner safety year in 1948, according to the National Safety Council. Last year's industrial injury rates show a substantial reduction in both frequency and severity of accidents to employees as compared with 1947.

The accident frequency rate for all industries submitting company reports to the council, based on the number of disabling injuries per 1,000,000 man-hours, was 11.49 in 1948—a reduction of 13 percent from the year before.

J. FREDERIC BYERS, SR., IS DEAD

J. Frederic Byers, Sr., chairman of the board of A. M. Byers Co., Pittsburgh, died June 11 in New York City. He was the son of the late Alexander MacBurney Byers who founded the company in 1864.

Among the survivors are two sons, J. Frederic Byers, Jr., and Buckley Morris Byers, both of whom are directors of the company.

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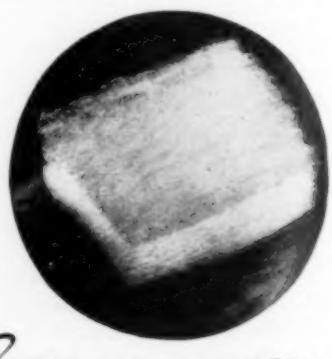

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CONTROLLING SCALE IN EVAPORATIVE CONDENSERS

After several "exchanges" on these pages, it appears that O. Germany and I are getting much closer to mutual agreement on the importance of desuperheating coils for reducing scale formation in evaporative condensers. The principal difference is one of viewpoint. Apparently Mr. Germany is considering the problem from the viewpoint of what is hoped to accomplish while my viewpoint is based upon a careful analysis of what actually occurs in field installations.

For instance, Mr. Germany states, in the June issue, "I am impressed with desuperheating coils for two reasons: first, because I believe that a desuperheating coil will increase the condenser thermal efficiency and second, that it will prevent considerable scale formation under certain conditions." These rather general statements are not borne out in practice and there is nothing in Mr. Germany's other comments to prove that the desuperheating coil does accomplish what he wishes it to accomplish under the conditions that prevail in the field.

Evaporative condensers are invariably selected to absorb a specified number of Btu's at a specified condensing temperature and wet bulb temperature. The inclusion of a desuperheating coil relieves part of the load from the wet coil and would thus *appear* to reduce scale formation by this reduction in the unit rate of heat transfer. That would all be true if manufacturers gave the desuperheating coils away "for free"—but that isn't the case.

Desuperheating coils are figured in as part of the total condenser capacity with the result that when desuperheating coils are furnished, a smaller size condenser may be used or in other words the rated capacity of the condenser is increased. Since the job with the desuperheating coil is figured for the same condensing temperature, it means that the loading of the wet coil is the same whether a desuperheat coil is used or not. It is this rate of loading, among other things, which affects the rate of scale formation. Therefore, I wish to emphasize that the addition of the coil cannot possibly reduce the tendency to scale formation unless the capacity of the desuperheating coil is ignored to the extent that condensing temperatures are figured for a lower level.

Mr. Germany's assumptions are based upon the use of desuperheating coils to reduce loading on the remainder of the condenser. He is correct in stating that this would reduce scaling, except for the fact that such practice is not followed commercially. Mr. Germany correctly states that scaling decreases with decreased loading on the condenser but I maintain that it makes no difference whether this loading is reduced by the selection of a larger size condenser or by the addition of a desuperheating coil so long as both applications produce the same loading as indicated by the same condensing temperature.

I am at a loss to understand Mr. Germany's references to increased "thermal efficiency" due to the use of desuperheating coils, especially where he also implies that the desuperheating coils are located in the inlet air to the condenser. Such an arrangement would cause a pronounced decrease in "thermal efficiency." Desuperheating coils are usually located in the discharge air from the condenser to take advantage of the low dry bulb temperature at that point without increasing the wet bulb temperature over the wet coil. If located in the inlet air stream, the capacity of the wet coil would be decreased.

The factors that produce scaling in evaporative condensers are fairly well established and certain rules of design and application are known to help control the rate of scale formation. These rules are:

1) Provide a positive water bleed to prevent excessive concentration of minerals in the recirculated spray water.

2) Use an ample flow of recirculated spray water to provide proper washing action over the tubes and to avoid any appreciable increase in concentration of minerals as the water flowing over the tube bundle is partly evaporated.

3) Include sufficient spray heads to distribute the water uniformly over the tubes.

4) Avoid selecting condensers for excessively high ratings even though operating in localities of low wet bulb temperature. This means supplying ample surface to avoid an excessive rate of heat transfer.

5) Provide chemical water treatment in those localities having unusually hard water supply.—D. D. WILE, chief engineer, Refrigeration Engineering, Inc., Los Angeles.

PREVENTING SCALING A WORTHWHILE INVESTMENT

Mr. Wile and I apparently still view the question of the importance of desuperheating coils on evaporative condensers from widely different viewpoints, probably because our comments were not confined to more specific limits. The problem at this point between Mr. Wile and myself may be one of semantics even more than one of a purely thermal nature.

In an attempt to resolve some of these differences, I want to list two fundamentals upon which my appreciation of desuperheating coils is based:

1) The evaporating water removes heat from the condensing refrigerant and also from the air as its dry bulb is decreased. Condenser exhaust air thus has cooling capacity proportional to the temperature difference between it and hot refrigerant gas.

2) Scaling will positively occur on the wet tubes wherever and whenever the solubility products of the salts in solution are exceeded at those particular temperatures. Scaling thus results in a lower heat transfer rate from refrigerant to spray water.

Consider now an evaporative con-

denser "adequately" sized from manufacturer's specifications to operate within a certain range of conditions and with no desuperheating coils. The cooling capacity of the exhaust air is entirely wasted. Let us see what this capacity loss amounts to: Evaporative condensers are usually sized to handle about 300 cfm per ton of rated capacity which amounts to about 21 lb per min of air or 1260 lb per hr of air per ton at 95 F DB and 75 F WB. Assuming a 15 deg differential between the hot refrigerant gas and the leaving condenser air dry bulb, $1260 \times 0.24 \times 15 = 4500$ Btu per hr cooling capacity of the exhaust air.

Required condenser capacity per ton of cooling is 12,000 Btu per hr plus approximately 2000 Btu per hr from heat of compression and miscellaneous friction heat gain, making a total in round numbers of 14,000 Btu. Assuming about 1000 Btu per lb of water evaporated, an evaporative condenser will vaporize about 14 lb of water per ton. However, where the dry bulb temperature of the condenser air is lowered, an additional amount of water is evaporated. If the dry bulb is lowered 5 F, then $1260 \times 0.24 \times 5F = 1500$ Btu or 1.5 lb per hr of water per ton additional has been evaporated. We have here 15.5 lb per hr total of water per ton evaporated.

With a total temperature difference of 15 F between leaving air and hot gas, the cooling capacity of air is 4500 Btu per hr per ton or the evaporation equivalent of 4.5 lb per hr of water per ton, $4.5 \times 100/15.5 = 29$ percent of the cooling capacity is wasted. Of course, this air cooling capacity cannot all be realized under any practical conditions.

Should desuperheating coils be placed on the above evaporative condenser to salvage some of the wasted cooling capacity of the exhaust air, the evaporative condenser would, of course, become "oversize." Furthermore, the desuperheating coils would not be supplied "for free," as Mr. Wile so eloquently explains it, by the manufacturer, which results in a somewhat increased condenser cost.

Suppose the outside surface area of the wet coils in this condenser (with desuperheating coils) were decreased such that its total capacity would be the same as it was originally with no desuperheating coil. The cfm per ton would still be the same and the spray water circulated would also remain the same. Here, then, we have part of the condenser capacity in the desuperheating coils and the balance in the wet coils.

Assuming no temperature change through the condenser and therefore a temperature difference of 10 F between air and hot gas temperature, the cooling capacity of air at 70 percent coil efficiency is $1260 \times 0.24 \times 10 \times 0.7 = 2100$ Btu per hr per ton or 2.1 lb of water evaporation equivalent. We then decrease the surface area of the wet coils so that only $14 - 2.1 = 12.9$ lb per hr of water is evaporated per ton or $15.5 - 12.9 = 2.6$ lb per hr of water per ton less than the original evaporation rate. This represents a 17 percent decrease in the evaporation rate and a corresponding increase in operation time within solubility limits. Scaling is then retarded by the relative increase in the spray water to wet coil loading ratio.

A condenser "adequately" sized and operating without desuperheating coils would scale less with a desuperheating coil added; Mr. Wile admits this. Scaling here is less because the spray water to wet coil loading ratio is increased with a desuperheating coil. The spray water to wet coil load ratio is likewise increased in an evaporative condenser with desuperheating coils whose total capacity is fixed but divided between wet and dry coils. It seems reasonable then to conclude, at least at this point, that scaling over a fixed period of time is less in a condenser equipped with a desuperheating coil than in one of the same overall capacity operating under similar conditions.

In evaluating desuperheating coils for installation on evaporative condensers, a set of limits have to be defined; otherwise the whole discussion is meaningless. Under certain conditions a condenser without desuperheating coil may operate all cooling season without scaling. Then, obviously there is no need here for desuperheating coils or any other additional aid for scale prevention. In cases where scaling might occur near the end of the cooling season, either a desuperheating coil, a water treatment apparatus, a larger condenser, or any combination thereof should be considered. I do not want to be forced into a position of advocating desuperheating coils as a cure-all. One method may be most economically feasible in one set of conditions and not so in another.

Since the mineral concentration of spray water increases with evaporation regardless of the amount of water wasted at the drain, within practical conditions, I want to emphasize the importance of considering mineral concentration of make-up water as well as wet bulb and condensing temperature in selecting an evaporative condenser. A great help along this line would be the compilation of data indicating the critical concentration of minerals based on mineral concentration of make-up water as a function of waste water and evaporation rate. From such data, desuperheat coils, water treatment, and condenser size can be more properly evaluated.

The whole idea of scale prevention can be summed up generally in that the concentration of minerals in solution must at all times be kept below the precipitation point. This condition is most critical at the terminal end of the spray water travel in the vicinity of the lower wet coils. When scaling begins, condenser operation is at the critical concentration point and proceeds rapidly from thereon.

Scaling indicates to me incorrect application and/or sizing of condenser and allied equipment. A well installed condenser should not scale.

Incidentally, my comments on desuperheating coils on the inlet condenser air in the June HPAC indicate a method sometimes used to keep the minerals in solution at the lower wet coils while operating near the critical point by raising the water temperature and increasing the mineral solubility. As long as the coils are free of scale the condenser efficiency does not decrease, other things remaining constant.

Whatever is done to prevent scaling for a particular set of conditions is generally a worthwhile investment whether this entails a desuperheating coil, water treatment, larger condenser, or any combination thereof.—O. GERMANY, Airtemp engineer, export div. Chrysler Corp.

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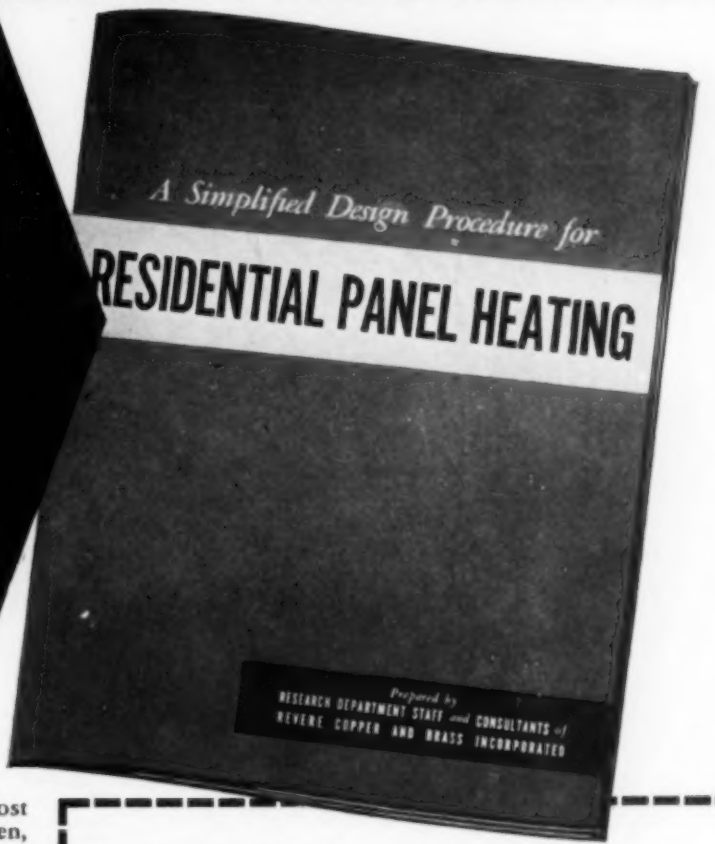
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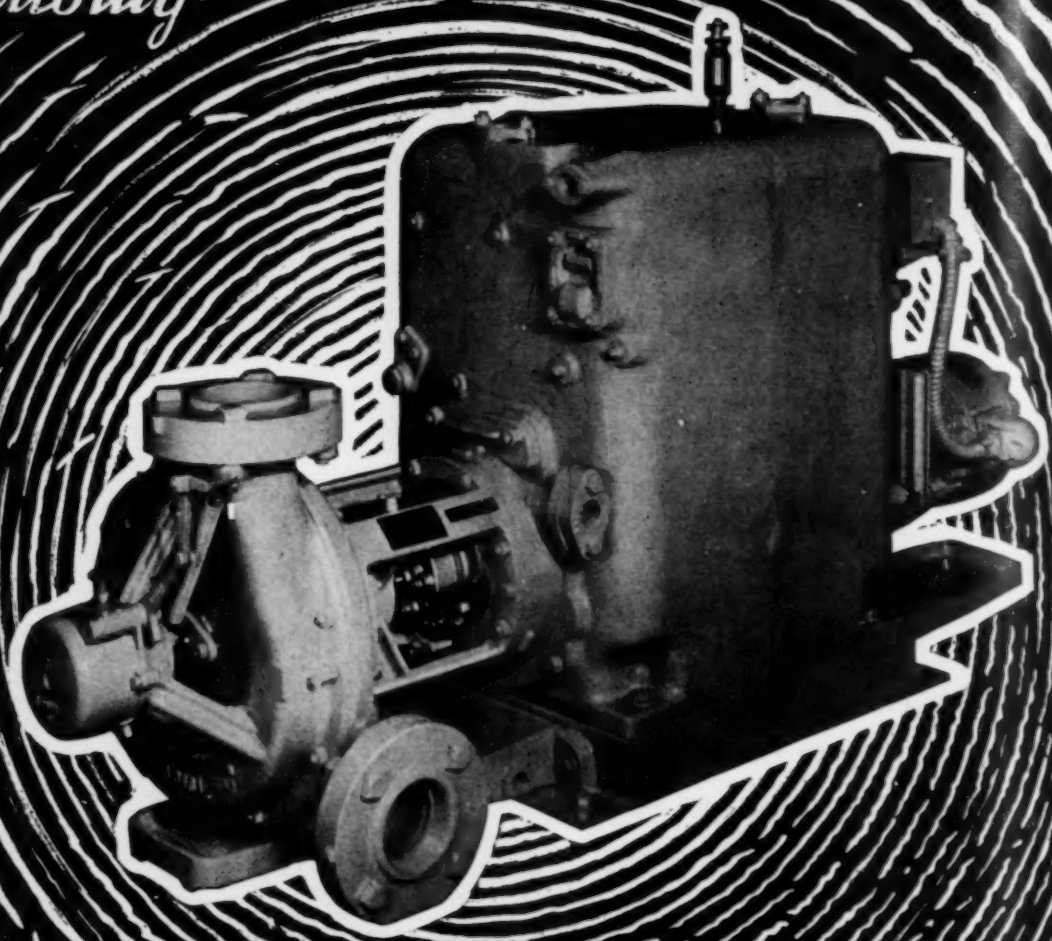

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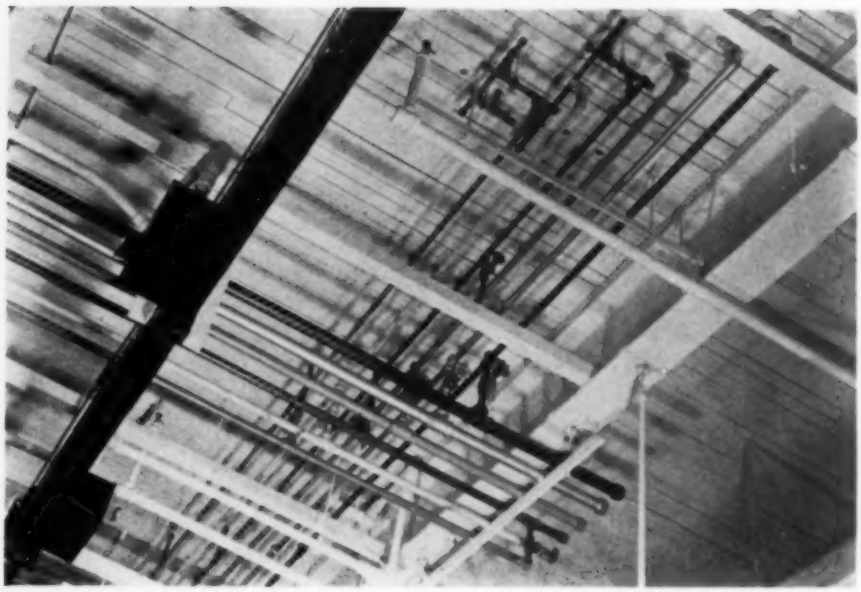

Flexibility is the keynote of the more than 40 miles of process piping. Here is a typical panel showing the method of supplying equipment connections from branch lines. The smaller piping and connections are referred to as "equipment connections," and the large piping and connections as "branch lines"

Development of Piping Services for Modern Manufacturing Plant

LOUIS F. CONTI, staff engineer, Allentown plant, Western Electric Co., Inc., gives here a thorough explanation of the complex problem of developing the piping service system for this new and modern plant for electronics manufacture. A network of over 40 miles of piping conveys 13 different services to all parts of the manufacturing building. The design thinking and planning, and the procedures and standards set up to accomplish the piping phase of the project, are explained in detail

THE NEW Western Electric plant in Allentown, Pa., completed in the fall of 1948, was designed to meet the exacting and complex demands of electronics manufacture. A wide variety of electronic devices used in telephone, radio and other communication equipment are made in the plant under conditions specially controlled and suited to their precise requirements.

The plant is located on a landscaped tract of 51 acres fronting on U. S. highway No. 22. Providing 445,000 sq ft of floor space, it includes an office and manufacturing building with connecting passageways, a boiler house, and a gas generating building. Among other structures are a concrete fire protection reservoir supporting induced draft cooling towers, a well pump house, and an acid neutralizing basin with its associated pump house.

The manufacturing building is 650 ft long by 375 ft deep. It is a two-story structure; the lower floor is partly below grade with a column spacing of 25 ft each way, and the upper or main manufacturing floor is of wood construction with columns on 25 by 100 ft centers to provide large areas of unobstructed space.

40 Miles of Piping for 13 Services

Beneath the main floor, a network of over 40 miles of piping conveys 13 different services to all parts of the building at prescribed pressures and flow. The development of the piping design followed a definite pattern. The problems presented by basic and broad considerations were resolved first, then—by progressively more detailed steps—the specific design was worked out.

Relationship of the Services to the Manufacturing Requirements—The nature of electronics manufacture is distinguished by three important characteristics in its relationship to the piped services required. These are: (1) The type of equipment used. (2) The many services required. (3) The need for layout flexibility.

The equipment used to manufacture electron tubes, thermistors, varistors, and other electronic devices is varied, complicated, and exacting. Of the more than 3000 units of equipment to be installed

in the new plant, about 2000 require two or more piped services; in a large number of cases, five or six are needed, complete with regulating and control devices. The equipment covers a wide range of operations, such as glass working, evacuating, plating, chemical cleaning, heat treating, coating, spraying, metal working, and many others. Most of the machines are of special construction and require special piping designs for installation.

The services to be conveyed, divided into two groups, consist of (a) gases and (b) water and steam. The gases are used to produce the flame and the heat through which —by the combination of glass, metals, and chemicals—vacuum tubes and other electronic products are made. Water is used for cleaning, cooling, and processing; steam is used for heating. The gas group includes hydrogen, oxygen, nitrogen, city gas, and low pressure and high pressure air. The second group includes cold city water, hot and cold softened water, deionized water, house or well water, steam, and its condensate return. All of these services are needed throughout both manufacturing floors.

Complete flexibility in the layout of manufacturing facilities is of extreme importance in this comparatively new industry. Rapid advances of the electronic art cause many changes in the design of the product and in its method of manufacture. When they occur, they lead to rearrangements of facilities which must be effected quickly and economically.

From the foregoing, the basic design requirements were established: A distribution system of 13 services widely distributed and available for easy connection to equipment at any point on either floor, set up in such a way as to provide maximum flexibility for future moves and rearrangements of manufacturing facilities.

Relationship of the Services to the Building—A great deal of thought was devoted to the relationship of the services to the design of the building. Investigations indicated that a two-story building with the main manufacturing operations on the upper level was preferable to a single story building for a number of reasons, the most compelling one being the decision to locate the services under the main operating floor and to serve both floor levels with one distribution system.

The advantages in so doing were many and important and are listed as follows:

1) Elimination of pipe drops from the ceiling to the main floor. Drops are objectionable because they serve as a resting place for dust which accumulates even in an air conditioned plant. When the dust is dislodged, it finds its way into the product, causing spoilage. In addition, the fine appearance of the main floor with its 18 ft high acoustical ceiling, its troffered lighting and its clear and unobstructed areas, is preserved.

2) Savings in initial cost, as well as in maintenance and the costs of future moves and rearrangements.

3) Greater ease of installation and maintenance with fewer interruptions to manufacturing work in progress and with less hazard to operating personnel.

4) Greater flexibility in layout and the moving and rearrangement of equipment.

5) Satisfactory provision for drains, the need for which originates almost entirely on the main floor.

In order to derive maximum benefit from this arrangement of the services, the main floor was built of wood. It consists of 3 x 6 planks laid on edge and spiked together, a covering of 10 lb paper and 33/32 in. maple flooring. When a service is needed, a hole is quickly drilled by machine to exact size and the pipe is brought up tightly at the exact spot where it is used.

These advantages deriving from consideration of the services were augmented by other factors. Relative to that of a single story, a two-story building provided:

1) More effective utilization of the tract initially and greater latitude for possible future expansion, due to the smaller acreage of the two-story building.

2) More suitable arrangement of activities with a more highly integrated layout.

3) Savings in overall costs, including initial costs, fixed charges, and operating costs.

4) More pleasing proportions with greater facility for architectural treatment and better appearance.

Sources of the Piped Services

The sources of the piped services, their quantity, and their quality, received considerable attention during the earlier stages of selecting a site. City gas was available from the street main in sufficient quantity. High pressure air is generated, using compressors of the carbon piston and ring type which run without oil or other lubrication, thus eliminating spoilage that would result if oil droplets or vapor came in contact with the product. The air leaving the common aftercooler of the compressor system is below room temperature and contains minimum traces of water, another definite advantage. Low pressure air is obtained from the high pressure mains through reducing stations at fixed points in the network instead of through a low pressure compressor system with a separate set of primary mains; this was decided after differences in safety, cost, and constancy of line pressure had been studied. Air is mixed with city gas to provide fires at the machines and it is imperative for best production results that gas pressures at points of use remain fixed and constant.

Whether to generate hydrogen, oxygen, and nitrogen at the plant or to purchase them compressed at high pressure in cylinders and delivered on trailers by reliable suppliers was settled after the main factors of safety, initial and operating costs, availability, and quality had been minutely examined. It was concluded to manufacture the gases at the plant. Hydrogen and oxygen are produced through electrolysis of distilled water; nitrogen and additional amounts of oxygen through liquefaction and rectification of air. This is done in the gas generating building and the gases are piped from outdoor high pressure holders to the manufacturing building, 1000 ft away, through a concrete pipe trench below grade.

Since the water available is not satisfactory for certain chemical operations and other uses due to the relatively high concentration of salts (including calcium and magnesium) it was necessary to provide a supply of purified water. For this purpose, a water softening plant with an operating capacity of 1000

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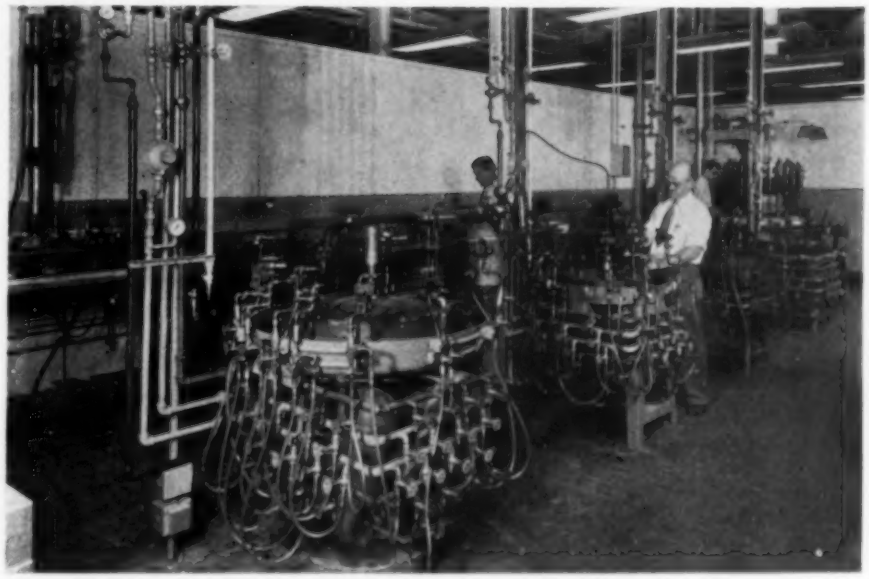
gpm was set up in the boiler house where raw water is zeolite treated or softened to render it more suitable. Here, the amount of solids is reduced from 240 to 8 parts per million, and the degree of hardness from 10 gpg (grains of calcium carbonate per gallon) to 0 hardness.

For water of exceptionally high purity demanded by critical processes, raw water is deionized or demineralized at an available rate of 16 gph, resulting in water superior to distilled water in purity or solids content.

To relieve the load on the city mains and to lower costs, a 500 ft deep well was driven which brings in a continuous supply of 225 gpm. Well water is used for house water supply to toilets and for non-manufacturing purposes.

The steam generating system consists of three oil fired, water tube boilers and one fire tube boiler fueled by industrial wastes. The total generating capacity is 63,000 lb per hr. The quantity of steam used for processing is only a small part of the total used for air conditioning and heating.



In conjunction with Western Electric's new manufacturing unit in Allentown, Pa., Bell Telephone Laboratories maintains a resident branch known as the Allentown laboratory. This is a view of the glass development laboratory on the lower floor, with service piping dropping from the overhead grid system.

Distribution

System Pattern

A radial system of mains offered greater safety and a higher degree of control than a loop system or combinations of the two. Moreover, it fitted more closely the plan of occupying the building progressively from east to west as construction and installations were completed in that direction. As a result, no other system received serious consideration.

The distribution system is composed of a series of mains, branch lines, and equipment connections. They are all compressed in the space 3 ft, 6 in. below the underside of the main floor, with the mains close to the underside of the steel floor framing (which consists of 27 in. deep girders and 18 in. deep beams). The branch lines and subsidiary piping are all above the underside of the girders. The establishment of rights-of-way at fixed horizontal and vertical positions presented a problem in coordination. The elements that had to be considered, in addition to the piping itself, were air conditioning ducts, electric bus ducts and lighting fixtures, sprinkler piping, and telephone and various signal systems—including their supporting members.

The feed mains are located in the center of the building 13 ft, 6 in. above the lower floor and run north and south, parallel to the 375 ft building dimension. They are arranged in two groups: the water and steam group, designated as Group A—house water, city water, steam, condensate return, and soft cold water—to the west of the center line of the bay, and Group B—high pressure air, city gas, hydrogen, nitrogen, and oxygen—to the east in the order named.

The feed mains connect downward to two sets of cross mains, one serving the northerly half of the building and the other the southerly half. They run east and west along the 450 ft building dimension.

Connected upward from each of the two sets of cross mains, at approximately equal spacing along their length, are five sets of branch mains running north and south on either side of the cross main. Each set includes both Groups A and B. There are, therefore, 10 separate sets of branch mains, five in the northerly and five in the southerly portion of the building, with each set of branch mains serving one-tenth of the building.

Encountered here for the first time are the branch mains for low pressure air, soft hot water, and deionized water. The low pressure air mains are established through five reducing stations located along each of the two high pressure cross mains. Hot water is generated on a local area basis by means of an individual instantaneous hot water heater for its own branch main. Only softened water is used to make up hot water. Similarly, deionized water, prepared especially for the chemical and plating areas but serving scattered processes in the general areas as well, now becomes part of the system. The deionized water branch mains are supplied by a feed main separately located. Hot and deionized water branch mains occur only when required in the area served.

From this point, the pattern of the distribution system becomes a function of the steel framing of the main floor. Columns of the lower story, on 25 ft centers, support the 27 in. girders which run east and west. The 18 in. steel beams frame into the girders at the third points of the span. Thus, every bay is divided into three panels, each 8 ft, 4 in. by 25 ft, 0 in. The panel serves as the repetitive unit area, or module, in which the distribution system terminates and the equipment connections start.

Details of Piping Within Panel

The details of piping within the typical panel and the bay probably received more intensive and con-

Principal metal working operations at the plant are concentrated in this ground floor area, where the overhead maze of power distribution, piping, and other service lines provides a high degree of flexibility. Columns are located on 25 ft centers throughout this area, directly beneath the 100 ft clear span manufacturing floor

centrated effort than any other single set of conditions in the entire piping system. It resulted in a series of standards with every feature of design carefully worked out and clearly shown. This was logical since services would be required initially or in the future in almost all of the 810 panels that make up the floor area.

The branch lines are now fed upward from the branch mains and extend about two bays east and west of them, terminating in plugged tees or caps. A branch line for each service is located in every north to south bay of the building —except for house, hot, and deionized water, which are installed only where needed. As they traverse the panels, the branch lines connect to equipment connections or will permit connection to future equipment connections through the use of plugged tees at the rate of one connection per panel per service.

The equipment connections, running between and above the underside of the 18 in. beams, parallel to them, terminate within the bay, being 16 ft, 9 in. long. Each equipment connection is equipped with one cross and three tees on 5 ft, 7 in. spacing, from which extensions may be easily installed to machines on either floor as required.

The pattern of the system having been fixed to provide the required flexibility and widespread availability, there remained the problem of adequate supply.

Minimizing pressure fluctuations of hydrogen, oxygen, nitrogen, city gas, and low pressure air at points of use is of great importance because the quality of the glass work produced is dependent on the characteristics of the fires being used. Glass fires at machines are set with painstaking precision to suit the nature of the work being performed. Once proven and set, the fires will remain constant unless pressure variations take place at the burners. When this happens, it causes defective glass work, necessitates readjustment of the fires, and results in lost time.

Pressure Drop, Pressure, Consumption, Pipe Size

Where hundreds of machines are being used and where the total load changes continuously as machines are placed in operation or turned off, fluctuations in line pressure will occur, especially in the larger sized mains which are subjected to a greater diversity of load. If the total pressure drop from feed point to the machine, however, is held to an acceptable minimum under conditions of full load, the resulting slight variations in pressure are tolerable and can be further reduced at the point of use to negligible amounts by means of pressure regulators. Based on experience, it was felt that an average overall pressure drop of 2 percent from feed point to the regulator at each machine could be tolerated. This figure was used in the determination of pipe sizes.

Excepting high pressure air, the gases are used at pressures ranging from inches of water column to 5 psi. Notwithstanding the fact that there were almost no cases of premixing of gases, that fire checks, flashback arrestors, and other precautionary devices would be used in accordance with rigid safety standards, and that all piping would be subjected to severe tests to eliminate leaks, it was judged best to distribute the gases at the lowest line pressures consistent with good operating results and to keep them all at uniform pressures, if possible. In line with this, hydrogen, oxygen, nitrogen, and low pressure air are distributed at 10 psi initial pressure and city gas at 7 psi. Hydrogen, oxygen, and nitrogen are, therefore, reduced from a transmission line pressure of 50 psi at the point of entry to the building through reducing stations, each station having two regulators in parallel. Low pressure air is reduced through 10 reducing stations located along the two high pressure air cross mains. City gas is boosted at the meters from approximately 4 in. W.C.

Pressure drops used for the other services are 2 percent for high pressure air and 1 psi per 100 ft of pipe for water and steam, with initial pressures of 100 psi, 45 psi, and 60 psi gage, respectively.

The sizing of the piping took into account the peak consumption of the services, the distribution of the loads over the manufacturing area, and the possible expansion of consumption as a result of new products and processes. From a series of studies based on the inventory method, records of overall usages and floor plans, hourly peak flows for each service were established for the entire building—taking into consideration all known data concerning new products to be made and new and changed processes to be introduced. For instance, it was known that more nitrogen would be used than in the past with the introduction of additional brazing and welding operations in atmospheres of forming gas, which is mainly nitrogen with varying small amounts of hydrogen. Simi-

larly, new heat treating methods would call for greater usage of nitrogen.

Estimates of the distribution of loads over the floor areas were based on existing typical layouts and on template layouts for the new plant, some of which were sufficiently far advanced so that loadings per bay, per branch line, and upward to the cross main could be fairly accurately computed for the first one-third of the building. From occupancy block plans, load distribution estimates were prepared for the balance of the building. The conclusion drawn from studies and tabulations was that the mains should be uniformly sized on the basis of the sum of the peak loads that might be imposed on any one set of mains under various combinations of occupancy. This did not result in any excessive pipe sizes.

It was the intention originally to size each branch line to carry its imposed peak load, holding to certain minimum pipe sizes for balanced design and contingencies. It was further intended not to install the branches unless they were needed since in some assembly, testing, and other areas piped services are not required. It became obvious, however, as installations progressed, that the difference in pipe sizes between the high and low loads is not appreciable and that many advantages could be gained by (1) using uniform sizes of branch lines for each service based on encountered or probable peak demands and (2) installing the branch lines in each bay throughout the building for their entire length. The uniformly sized branches would provide for all conditions except the pile up of abnormally heavy loads, which if ever met would not result in too serious a change since each branch line is about 50 ft long and straight sized tees are installed on the mains at the points of connection. Uniformity introduces, in addition: greater standardization with attendant savings in cost of design, installation and maintenance; fewer parts to stock; greater speed of installation; and other benefits. Complete installation permitted the use of mass production assembly and installation techniques and provides for future rearrangements which then will mean only the relatively minor job of supplying the equipment connection and its extension to the machine. In this way, manufacturing operations could be started sooner. Getting the branches in initially with the economies that could be thus effected, doing it while the building was yet unoccupied and providing for future savings, far offset the added initial cost, the more so since most of the branch lines would be installed eventually as changes in layout took place.

These "Ladies in White" perform the delicate job of assembling the elements that go into electron tubes. Each row operates as a team; each team, beginning with the girl on the left, does a complete assembly job. So sensitive are these electronic tubes to moisture, dust, lint, and other foreign matter that the building is completely air conditioned and the employees wear special lint-free smocks

In computing pipe sizes for the various services, tables and charts based on the following formulas were used:

1) Weymouth formula for gases—pipes 3 in. and over.

2) Cox formula for gases—pipes under 3 in.

3) Saph and Schoder formula for water.

4) Babcock formula for steam.

Shown in Table 1 are the pipe sizes of the distribution system for each of the services.

Selection of Pipe Materials

The type of material to use for the various services received careful attention at an early stage since the plant was built during a period of material scarcity and the large quantities involved meant procurement difficulties, some of which could be overcome by placing orders far in advance of their scheduled use. Every effort was made to standardize the materials. Their selection was based on accepted practice, good performance initially and in the future with a minimum of maintenance, long life,

Table 1—Pipe sizes of distribution system

Name of service	Nominal diameter of pipe, in.			
	Feed mains	Cross mains	Branch mains	Branch lines
House water	6	4	3	1½
Steam	8*	4*	2	1¼
Condensate return	2*	2*	1¼	1
City water (cold)	6	4	3	1½
Soft cold water	6	4	3	1½
Soft hot water	–	–	1	¾
Deionized water	1½	–	1	¾
Oxygen	2½	2	1½	1
Nitrogen	2	1½	1¼	1
Hydrogen	2	1½	1¼	1
City gas	3	2½	2	1¼
High pressure air	6	4	3	1½
Low pressure air	–	–	3	1½

*Also serves the air conditioning and heating systems.

Designed to meet the fast changing demands of electronics manufacture, the new Allentown, Pa., plant of Western Electric Co. combines ideal working conditions with a degree of flexibility seldom attained in a manufacturing plant. Behind the buff face brick and limestone walls, with their double glass vision strips, upwards of 2500 people can perform, without interference, the hundreds of divergent processing and assembly functions involved in the design and production of vacuum tubes, mercury relays, precision resistors, and other equipment used in telephony and radio communication systems

ease of installation, suitability for the service conveyed, and safety.

Other features of the use of materials included the following:

1) Only one type of union is used for each service with the figure number and make specified to insure interchangeability.

2) Type of packing and disc material for all valves were specified. Thus, hycar discs of No. 80 hardness are used on hydrogen and micarta discs on oxygen. The other services are less critical, but in each case the material was named. Braided asbestos packing free from oil, grease or graphite, and lubricated with a special grease was specified for oxygen.

3) All valves—gates, globes, angles, needle points, checks—were specified by model number and make, and no substitutions were permitted.

4) Lubricated service cocks are used on city gas service except on the smaller sized equipment connections where valves are used.

5) Joint compound was specified for each service.

6) Standard red brass pipe, IPS—OD and thickness is used in place of copper tubing where there is danger of physical damage to piping on hydrogen and oxygen service or where a changeover was made from silver brazed joints to threaded joints. Standard bronze threaded fittings are used in the latter case.

7) All valves and specialties on oxygen service were supplied free of oil and grease by washing with carbon tetrachloride or equivalent, and delivered in protective wrapping. In this connection, prior to installation, all pipe, fittings and other material used on oxygen service, except those previously cleaned, were washed in a hot solution of trisodium phosphate and rinsed thoroughly in hot water. This was done in special baths in the field.

8) All valves were procured with handwheels painted in the color identifying the service according to the standard color code, and also carried aluminum plates with the name of the service printed on them.

Methods and Means

In order to cope with the physical aspects of the job, to achieve economy and efficiency of design and installation, and to make available for future use the mass of knowledge and experience gained, the routines and techniques developed, and the records and data accumulated, an integrated system of planning methods and means was developed, some of the main features of which are described below. Through their use, the providing of facilities and the installation of equipment progressed on an orderly and methodical basis, in spite of the difficulties encountered because of limited personnel, changes in overall planning, layouts, and installation schedules and material shortage during the early part of the job.

Equipment Identification and Inventory—In order to prepare exact layouts, manage the transfer from New York City and other locations, and design the installation of each of the thousands of items of equipment involved, it was necessary to identify the equipment, study its requirements, and proceed accordingly. Since all this ground work was necessary at the very outset, it was deemed best to go somewhat further and to set up a permanent system of identification and inventory.

Each item of equipment is identified by means of two 1 to 3 digit numbers separated by a dash. The first is coded for classification of equipment and the second is a serial number within that class. A plate is then prepared and attached to the equipment, bearing its identification number and references to operating and maintenance instructions.

The inventory consists of a separate card for each piece of equipment. The card contains information pertinent to its cost, installation, servicing, operation, maintenance, and procurement. A sorting system provides a flexible and efficient means of compiling equipment data by class, location, services required, year of acquisition, account, and other groupings. The result is a valuable continuing record of plant equipment.

Standards (FSA Drawings)—The use of approved standards accomplishes the following:

1) Eliminates duplicate investigative effort.

2) Establishes uniformity in procedures, materials, and methods of design and installation.

3) Reduces design and installation time and effort.

4) Reduces the burden of maintenance, repair, replacement, procurement, and stocking of materials.

5) Properly maintained, they provide a higher degree of control over design and installation and lead to greater efficiency, economy, and better appearance.

The first standards developed specify the working tools for the draftsman and designer. On standard 8½ x 11 sheets, conveniently kept in book form, they cover such items as:

a) Process piping terminology.

b) Identification symbols and colors (plan, line, legend).

c) Material specifications.

d) Consumption data for burners.

e) Piping symbols (elbows, tees crosses, unions, etc.).

f) Standard abbreviations (uniform method for use on drawings).

The second group specifies the design, the installation methods, and materials to be used on items repeatedly encountered. They cover such items as:

a) Distribution system standard (showing the typical bay and typical connections to the branch mains in the bays where the latter occur).

b) Distribution system network.

c) Standard floor holes and wood plugs.

d) Filter, reducer, and lubricator unit installation for HP air operated equipment on bench.

e) Sediment pocket for HP air, city gas, and steam.

f) Filter assembly for HP air.

g) Cooling control assembly on cooling water lines.

h) Selection table for standard hose and hose fittings.

i) Solenoid valve assembly for automatic shutoff of air or gas lines.

j) Trap assemblies on condensate return lines.

k) Pressure reducing valve assemblies for steam.

l) Installation of gas and air regulators.

m) Installation of hot water heaters.

n) Methods of supplying bench headers (upward through the floor; downward to the lower floor; from the back; from the ends; two, three, four, five, six, or seven headers; etc.).

o) Gas and air outlets at benches (above, below, etc.).

p) Gas piping for free standing equipment.

q) Standard pipe hangers.

In many cases, complete machine installations were standardized where they covered more than one machine, with variations detailed on the same sheet.

Equipment Drawings (ESE Drawings)—At an early date, it became necessary to develop a means of obtaining for each piece of equipment its exact dimensions and required clearances for layout purposes, a way of showing how it was to be installed, and the materials required. Several methods were tried, but one appeared to be superior to the rest—judged by the amount of time needed in relation to its complete adequacy. This is a simplified isometric drawing of each equipment drawn to scale showing dimensions, clearances, single line detailed service diagrams complete with fittings, specialties and controls, and with consumption data and material lists for ordering and installation. It also shows, relative to the equipment, the exact spot at which the services come up through the floor. This has oftentimes enabled the equipment connections to be run from the branch line through the floor, ready to be extended to the machine as soon as it was received and properly positioned.

Great proficiency was acquired in the execution of these ESE (electronics shop equipment) drawings and to date more than 1500 have been completed on piping alone. Through their use, it was possible to keep as many as 150 contractor's men busy with piping installations with a minimum of supervision, yet with resulting high standards of work.

Their value for future rearrangements is as great as for the initial installation. No further detailed engineering effort is required since only a short tie-in to the grid system, itself completely standardized, is needed for a reinstallation job in a different location.

Installation Drawing—The remaining link in this chain is the installation drawing covering 1/16th of each floor separately and drawn to 1/4 in. scale. This drawing shows the exact location of the equipment, being a reproduced copy of the layout drawing. The details of the equipment connections are shown here from the tee or cross in the branch to the point at which they either rise through the main floor or drop to the lower floor. The balance of the piping is picked up on the ESE drawing.

The piping installation drawing is prefixed with the letter P. Similar drawings exist for equipment layouts (prefix L), electrical (prefix E), and mechanical, covering ventilation and exhaust, (prefix M).

When feasible, two or more of these drawings are incorporated on one sheet for the 1/16th of the floor covered, whereupon the prefixes are combined—for example, PE to indicate piping and electrical. This is logical if the possibility of confusion, due to overcrowding, does not exist because the electrical conduit is supported on the same uniform hangers as the piping, occupying a standard number of positions and running in fixed channels parallel to the piping.

Through all of the phases of planning, design and installation, every effort was expended to keep the quality of the piping work on the same high level as that achieved structurally and architecturally by the building. It appears, from the tests to which the system has already been subjected, that it will adequately fulfill the many and complex demands for which it was designed.

IMPROVE COAL FIRED BOILER PLANTS

Improved methods of coal handling and utilization in small and medium sized boiler plants are expected from research now being conducted by Bituminous Coal Research, Inc., national research agency of the bituminous coal industry. According to V. G. Leach, chief combustion engineer of Peabody Coal Co., Chicago, and chairman of the BCR industrial utilization committee, this research has already provided valuable design and operating information for small industrial plants.

Mr. Leach described the attack on boiler plant improvement at the annual meeting of the BCR at Columbus, Ohio. The BCR, he said, is conducting a short-range program to help improve existing plants and is engaged in research leading to the development of new equipment.

The BCR recently published a booklet, How to Cut Small Boiler Plant Costs by Mechanical Coal and Ash Handling. This publication is based on the use of available proved equipment which will make coal handling more automatic in the small plant. Economy of operation and the use of coal as fuel amortizes the equipment costs.

The BCR is conducting exploratory research that will permit the development of automatic boiler units which are competitive in cost to equipment using other fuels, are free from smoke emission and fly ash nuisance, and will be able to burn a wide variety of coals. On the basis of surveys now going forward, and research that is planned, the BCR will obtain the necessary data for the design of suitable fly ash collectors for the small boiler plant, he said.

AIR *for Healthful Living*

LESTER T. AVERY, president of the Avery Engineering Co., Cleveland, has long stressed the importance of air conditioning for health —not just comfort. In this readable and brief (but comprehensive) review of the subject, he touches on many phases—including the proper temperatures and humidities to maintain and the many other qualities of air in addition to dry bulb temperature and relative humidity. His observations are based on a wide experience, not only in air conditioning for comfort but also industrial process work

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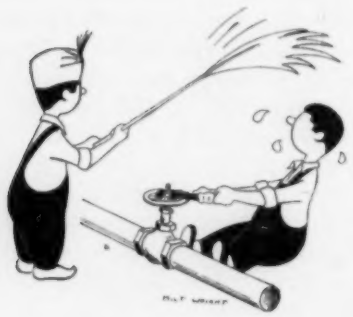
In one of our local newspapers there is a health column which covers "Today's Question." Today's question that prompts this article is "At what temperature should a home be kept during the winter months?" The column's answer to that question is as follows: "This was studied during the war to *decrease* the use of fuel. A temperature of 70 during the day is satisfactory for *healthy* people, although many persons have done very well at temperatures considerably lower."

Do we need a better place to start a discussion on air for healthful living than to consider how this reply fails to answer a very real and vital question? There are many other questions that we must ask about air. What is the best humidity? How clean should air be? How much air motion? How much fresh air? What are the things we must know about air to make it good for healthful *living?*

May I distinguish here between air for ordinary living purposes, air for process work in industrial plants, and air for treatment of disease? Let us direct our attention to the air that we breath or the air that we live in as normal human beings engaged in normal activities. We will try to determine what we do know and what we don't know of the qualities or properties of air to make it best for general living purposes.



Air Taken Too Much for Granted

Air has been taken too much for granted. The body will (or tries to) adjust itself to almost any kind of air from the Equator to the North or South Pole. It can stand up in a blizzard on the deck of a ship or it can go into deep mines where temperatures are high and humidities are oppressive. The body is a wonderful machine. The body used to do the same thing about water and food, but we have found it is *worthwhile* to control some of the qualities of food and water. We know now that drinking water should be pure and should be no colder than 50 F. We know that food must be clean and properly prepared and we have laws governing the serving of food in public places.

Pasteur recognized airborne germs as early as 1859. He announced in 1880 that "dusts are the exclusive origin of life in infusions," that is, airborne germs were contaminating wine and beer. From his early work we have developed a complete procedure of pasteurization, but this deals chiefly either with preventing the material from coming in contact with air which may have contaminating bacteria in it or else in sterilizing (or "pasteurizing," as we say) to kill such bacteria *after* they have gotten into the liquid. Milk, wine, and beer are three products most definitely connected with pasteurization. Sedillot, in 1878, coined the word "microbes" in the air. So while we do take air for granted, we have known for over 70 years that there are such things as airborne bacteria and the wonder is that we haven't paid more attention to them.

In addition to germs and bacteria, we have other types of atmospheric contamination coming from our industrial activities. Smoke, carbon, and fly ash from combustion; sulphur dioxide and sulphur trioxide; carbon monoxide and carbon dioxide; the various fluorine derivatives; dusts, silica, lint, abrasives of all kinds; solvents, carbon tetrachloride and alcohols; fumes from anodizing tanks and other liquid baths; enameling dusts, frit; products of blast furnaces and cupolas; fumes from ovens, paper manufacturing, rayon—all of these are problems.

If you were to choose any industrial city and analyze its atmospheric contamination at different times of day at various seasons and directions of wind flow, you would find practically *all* of these contaminants in some quantity or other. We have justifiably put the

emphasis on trying to clean up these contaminants at the source, but we have been negligent as to what to do about the air when we really want it clean. A recent example is the tragedy at Donora, where people actually were killed in this valley due to the atmospheric contamination which was ordinarily removed by wind blowing but which became too concentrated due to lack of natural air currents. It sometimes takes a dramatic happening to bring into the open a problem which has existed for many, many years.

In preparing this material, I reviewed the Transactions of the American Society of Heating and Ventilating Engineers, which include papers presented at various meetings and the discussions on those papers. The ASHVE has done a great deal of work during the past 20 years in studying physiological reactions of people to their environment, particularly dealing with air temperatures and humidities and to some extent air purity. Papers have been presented before the society by many investigators, engineers, physiologists, doctors of medicine, and industrial hygienists during the past 20 or 25 years. May I recommend this material as it paints a pretty good picture of air for health?

We Talk "Comfort," Avoid "Health"

As engineers we have avoided the use of the word "health," and we have insisted on describing "comfort." Any doctor will tell you that "the body well" is "the body comfortable" and what the physician tries to do is to remove the symptoms of discomfort. Therefore, when we talk about a "comfort zone," we really evade the question and speak of a wide range of temperatures and humidities which are *tolerable*. The doctor is not familiar with this zone, has very little knowledge of the "effective temperature chart," and still talks in terms of dry bulb temperature. We have been using the effective temperature chart and the comfort zone in design and yet have hesitated to determine the limits for healthful living. We have been waiting for the medical profession. We have about come to the conclusion that the medical profession is waiting for us to bring together the information we have, which together with the information they have will help us all come closer to the definition of what is the right kind of air for healthful living.

Many air conditioning installations in industry prove that 69 and 71 deg effective temperatures are the limits within which large numbers of people are satisfied, says the author. This photo shows a crystal assembly room where the same 71 deg effective temperature is carried the year 'round

Insofar as temperatures and humidities are concerned, we have found that the closely controlled installations made during the war, where the product was the determining factor, happen to be the best installations from the comfort or health standpoint. My personal opinion is that we should limit the so-called comfort zones to a very narrow range of 69 to 71 deg effective, winter and summer, with a minimum of 30 to 35 percent relative humidity in winter and a maximum of 50 to 55 percent in the summer. This, therefore, gives us a range from 74 to 77 F dry bulb temperature with the humidity varying somewhat from season to season.

Within these limits we satisfy large groups of people; for example, in shop work with hundreds of women and men working side by side, in accounting departments and telephone toll rooms, and other places of large mass employment. There are individuals who like it cooler or warmer and they are special cases. What we want to do now is follow through on a large number of installations with thousands or hundreds of thousands of people who are working within this general range of 69 to 71 deg effective and to determine that it *is* the *most healthful* temperature and condition.

One of the great difficulties is that you cannot keep people in this environment outside of working hours. None of them has such control at home and certainly the local transportation vehicles leave much to be desired. Full 24 hr experimental work could only be done in a place of continuous occupancy (such as a prison) where the subjects were kept continuously in the environment. There is much to be said for a changing environment, changing temperature, changing pressure to stimulate activity, etc., but we're talking now about ordinary working conditions for people indoors. Let them get their stimulation by *going outdoors*.

A recent booklet has been published by the CIO textile workers' union on air conditioning in textile mills [see HPAC, December 1948, page 65]. Here, the emphasis is on "healthful and safe" working conditions. Nothing is said about comfort as such, but it is claimed that in textile manufacturing air conditioning pays by increasing the efficiency of the work. This booklet is a "guide" for unions in negotiating with management as to working conditions. The steel workers' union is investigating the conditions from atmospheric contamination at Donora. We have long known that deep mining required

special conditioning for safe work. We, therefore, find a new emphasis being placed on this subject by the workers' organizations who look toward benefiting the worker in health and the reduction of accident and disease. We can expect to see more emphasis on working conditions. Forward-thinking management recognizes too the value of good air. The Sappington survey, sponsored by the Industrial Hygiene Foundation, says: "The worst health menace to the working man is air contamination."

To those who wish to study further on the subject of industrial health and air contamination, I recommend a book called Industrial Hygiene Engineering, by Allen D. Brandt [reviewed on page 271, January 1948 HPAC]. It includes a complete list of contaminants and suggestions as to their control. There is also a new book by Earle B. Phelps entitled Public Health Engineering [page 169, December 1948 HPAC] which has a large section dealing with air. This book emphasizes the desirability of "minimum strain." In both of these books, air for *health* rather than comfort is dealt with. This leads us to the next step, which is air purification—a subject that has recently made headlines in many magazines and papers.

During the war Dr. Edward Bigg, Professor B. H. Jennings and F. C. W. Olson at Northwestern University made a study of the use of glycols for air sterilization. Their findings were reported to the ASHVE in a paper (page 103, May 1947 HPAC] on which there was much discussion. This report formed the basis for articles in Hygeia, Reader's Digest, and various Sunday supplement magazines, all of which led to a barrage of calls to many of us: "How do you get this glycol in the air to kill the common cold?"

Studies have pointed out that any method of air *cleaning* is beneficial in ridding the air of the airborne, dustborne bacteria. Recent work at the University of Chicago [page 206, August 1948 HPAC] shows that some bacteria cannot stand 50 percent relative humidity. Some work shows that simple air washing is very beneficial. Certainly, electrostatic air cleaning not only removes the small dust particles and with it any dustborne bacteria, but the electric charge itself apparently has some bactericidal effect. Methods of dehumidifying air chemically can't help but remove bacteria along with dust. Activated carbon, which is used widely for removing certain gases from air, also stops airborne bacteria. All of these methods, therefore, have not only the air cleaning characteristic but include some bacteria removal. And we have come far enough now to say that *any method of air cleaning* is better than none, some are better than others, and it is possible by the proper combination of air filters, electrostatic cleaners, and air purifiers to insure a high quality air for any use—especially for people.

Another method of air purification is by means of ultraviolet lamps, which can be located in the space being used or placed in the ducts leading to the space. Such lamps are widely used in the pharmaceutical industry and in some meat curing processes.

How Much Recirculation?

The quantity of air required for good ventilation has been studied, and a recent paper presented by Consolazio and Pecora of the Naval Hospital at Bethesda, Md., points out that it is almost impossible to reduce the make-up air to the point where there is insufficient oxygen, but it may take anything from 5 to 53 cfm per person to dilute to the extent of getting rid of body odor. Various methods of deodorizing have been tried (many of them without much success except for an anesthetic action, which means you don't notice the bad odor because you can't smell anything). It is pretty generally recognized that to get rid of odors you must clean the air, remove the gases, and dilute with uncontaminated air. The balance is determined on the basis of cost of purification as against the cost of bringing in excessive quantities of make-up air.

There is one school of thought which insists that all air should be outside air, no air recirculated at all, and there is much to be said for this method of approach. It is not economical, however, in many cases. Certainly, it would be a great expense to heat a private home (or cool it, for that matter) with 100 percent outside air. The discriminating engineer has to strike the proper balance between how far to go in handling excessive quantities of make-up air or in reconditioning or reclaiming recirculated air. There is no simple solution and good engineering implies a good balance.

A most important question is: Where does the outside air come from? I could show you many installations where the make-up air is contaminated due to the neighbor's exhaust system or due to the general atmospheric contamination of the area, and where it would be actually simpler and less expensive to recondition the inside air than to precondition the make-up air. There is no particular virtue in outside air, once you get down from the mountain top. Look where it comes from. It may not be very "fresh."

More Data Needed On Humidification

Further work needs to be done in studying the value of winter humidifying. Obviously, dry air which comes with the cold winter months in the northern climate does increase the abrasiveness of airborne dust, does tend to dry out animal's fur and plants, and the human body being a large part water is subject to this same dehydration. We believe that relative humidities should be kept around 25 to 30 percent for health, but we have no *proof* that this is accepted medically. It is true, however, that from the simple comfort standpoint, as the relative humidity drops, the temperature must be increased—which accounts for some of these excessive 80 and 85 deg temperatures carried in apartments, hotels, etc., in the wintertime. If you follow the effective temperature lines, you just naturally will want to do something about humidity in order to keep the temperatures within reasonable range.

Is There a "Shock Effect"?

There has been some "gossip" that the shock effect when going from an air conditioned interior to an excessively hot exterior is bad for health, or that the reverse—walking from a warm street into a

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properly conditioned office or a store—has a bad effect. In fact, I've been told by people that they saw women fainting on the sidewalk in front of an air conditioned store due to this shock.

This subject was investigated and is still being investigated by the University of Illinois medical school in Chicago. This work has shown there is *no health hazard* that can be measured, and that the notion there is a hazard in this "shock" has no basis in fact. This confirms our general observation that the ordinary worker in the dairy plant or the packing house who goes from a refrigerated room to a hot shipping platform has never been considered an industrial hazard and has no record of occupational disease. I think we can attribute this feeling of shock simply to the strange feeling of coolness which comes to us, as not all spaces are conditioned in the summer. We are used to the shock of walking from a superheated office or apartment or home onto a blizzard-driven street or vice versa in cold weather. We are used to sitting and baking on a beach in the sunshine in the summer and then diving into water that may be as low as 68 F. I even was silly enough, when in the Navy, to dive into the Bay of Fundy with the water temperature down around 45 F. Sure it was a shock, but apparently one of those things to which the body can adjust itself.

As more and more stores, offices, restaurants, places of amusement, vehicles, and private homes are completely conditioned, there will be less and less of the feeling of shock as we will get used to it. I think right now is a good time to re-emphasize that there is *no health hazard* in passing from a properly conditioned space to the unconditioned outdoors or vice versa.

We consume 3 to 5 lb of food per day and can get along many weeks without it. We take in 5 to 8 lb of water per day and can get along several days without water. We consume 30 to 40 lb of air per day, and we can't last three minutes without it. We, as engineers, have the technique to control the air as to its temperature, humidity, motion, and quality; that is, its purity with relationship to gases, fumes, mists, or dusts. We have been waiting—perhaps too long—for some other group to tell us what kind of air should be prescribed and we have backed away from the implications of "health" and put all of the emphasis on "comfort." We know that air carries bacteria, microbes, and spores and we know how to clean them out of air. We have pretty well determined that the best zone within the comfort zone for ordinary persons, which may well be considered the "health zone," is in the range from 69 to 71 deg *effective* temperature.

The year 'round 69 deg effective temperature carried on this VT fuse project was entirely satisfactory to the men working in the punch press room, and these women in the assembly room

What's Left To Be Done?

What is left to be done? Well, there's plenty—and everyone engaged in this business can cooperate and exchange information which bears on this very important subject. The American Society of Heating and Ventilating Engineers is trying to keep in close touch with all institutions, hospitals, medical schools, laboratories and others who are doing work along physiological lines. Right now, the ASHVE has a new program involving the construction of a human calorimeter done under the supervision and with the cooperation of the Navy. The University of Illinois medical school has a number of psychrometric rooms and is building additional ones for study on the human body. Many hospitals, medical schools, and laboratories are working on physiological problems. A quick and close coordination of information coming from all sources is required.

One of the most important steps would be to provide a controlled environment for a large mass of people for long periods of occupancy with a study as to health, energy output, and freedom from the common cold (which takes such a terrible toll each winter). It's easy enough to say that air conditioning has not proved any great health value from that standpoint, because some users have been unable to get any significant data on the subject. My answer to that is simply that they do not keep their people in this environment long enough, that the seven hours they work is counteracted by 17 hours when they are eating, playing and sleeping in an uncontrolled environment which may be overheated, under-humidified, full of dust and airborne bacteria, or just plain exposure to others who are ill.

As we review what has gone before, we see that it won't take much additional work to define and deliver air controlled for healthful living.

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The Equipment Developments and Recent Trade Literature columns published each month in HPAC are intended to keep you posted on new and improved products. Be sure to read these departments regularly.

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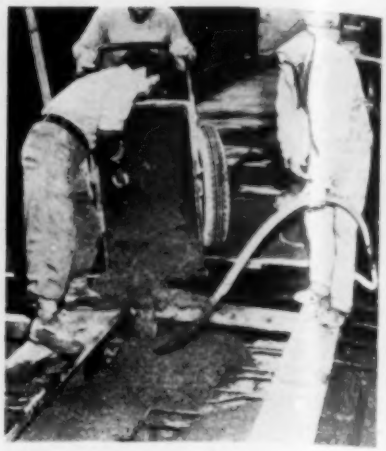

NEW PAVEMENT BASE was designed as a self-supporting structural slab, 5 in. thick, without supporting beams. Here workmen pour concrete over reinforcing rods to form this slab

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Snow Melting Sidewalk

STEP-BY-STEP PICTURE STORY

THERE SHOULD BE no ice or snow problems in front of the Duquesne club in Pittsburgh this winter. A snow melting sidewalk has been installed along the club's 116 ft frontage on Sixth Ave. in Pittsburgh's "Golden Triangle."

Hot water circulated through 1500 ft of wrought iron pipe embedded in the concrete sidewalk will melt snow faster than it can fall and ice faster than it can form. An outdoor air thermostat automatically starts the pumps working at the first hint of ice or snow. The grid system is unused during the warm months of the year.

The 1300 sq ft sidewalk was completed last winter in time to undergo several effective trial runs. The winterproofed slabs lived up to expectations by melting up to 1 in. of snow or ¼ in. of ice per hr. In addition to having a sidewalk that was free of snow and ice without use of manual labor and snow shovels, ice chippers or chemicals.

AT THE SITE, the prefabricated sections are welded together into two main grids. These pipes carry the 130 deg water and antifreeze mixture which heats the pavement

IN POSITION on top of the insulating blocks, the assembled grids look like this. The system was tested for 24 hr at 100 lb per sq in. and found to be water- and airtight

A CUSHION OF sand and gravel fill over the piping makes it possible to eliminate pipe expansion loops. If piping crossed construction joints in solid concrete, loops would be used

INSULATION is provided by foam glass blocks 2 in. thick which are laid over the hardened slab. These reduce heat loss to the open area below the pavement

PREFABRICATION of wrought iron pipe grids takes place in the shop of the heating contractor for the job. The piping is 1 in. standard weight spaced 1 ft apart

SNOW MELTING SYSTEMS for driveways, docks, ramps, sidewalks and hazardous streets represent "a limitless field which needs only to be tapped," the members of the Heating, Piping and Air Conditioning Contractors National Association were advised by the HPACCNA committee on trade promotion at the association's recent annual convention. The story of a sidewalk installation is told here step-by-step in pictures taken on the job

there were several other advantages to the installation, according to the club. Safe and dry footing was automatically provided for pedestrians and club members at all hours. There was never any snow removal or snow drifting problems. No snow was banked along the curb, and thus access to the club by car was facilitated. The most ardent admirer of the snow melting system, however, was the club doorman, who boasted of warm and dry feet as the slush piled up on neighboring sidewalks and streets.

Although radiant heating installations are now commonplace in residences and places of business, outdoor installations are still comparatively rare. The number of such installations is increasing, however, and engineers predict that the era of usefulness of the method has just begun. Interest is particularly high at air fields, where snow removal and flights cancelled because of snowbound landing areas are costly factors.

The Duquesne club sidewalk is constructed of a 5 in. heavily reinforced structural slab; 2 in. of foam glass insulation to reduce downward heat loss; grids of 1 in. pipe on 12 in. centers; approximately 2 in. of washed gravel; and a final concrete slab about 3 in. thick.

The piping is in the form of two grids with supply headers at the extreme ends of the sidewalk and return headers on either side of a steam heating company's manhole. The supply and return mains and headers are 1½ in. pipe. All connections are welded.

Hot water at a temperature of about 130 deg is supplied by a shell and tube heat exchanger, the source of heating being 15 psi steam from an existing main in the club basement. The steam is supplied from a centralized source by the Allegheny County Steam Heating Co.

The hot water, mixed with about 40 percent ethylene-glycol antifreeze, is circulated by a 3 in. booster pump. Facilities have been provided to remove air from the system at high points and to drain it through a connection in the basement. Water in the heat exchanger is automatically maintained at the desired temperature by a regulator which controls the flow of steam.

The pipe used in the installation includes 1500 ft of 1 in., 300 ft of 1½ in., and 200 ft of 2 in.

The Trimble Co. was the general contractor and Sauer, Inc., was the heating contractor.

TOP LAYER of concrete, 3 in. thick, is poured over a light reinforcing mesh which has been laid on the piping. Meanwhile, the piping has been connected to the club's heating system

HIDDEN HEAT lies buried in this 1300 sq ft of pavement capable of melting up to 1 in. of snow or ¼ in. of ice per hr. Outdoor thermostat starts pumps working in cold weather

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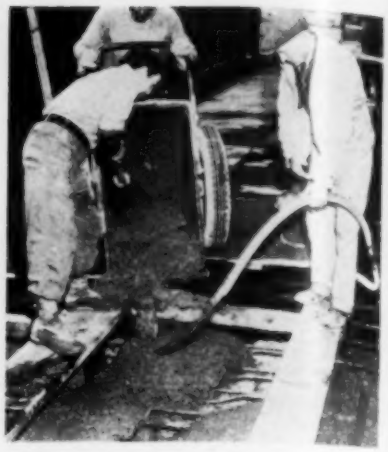

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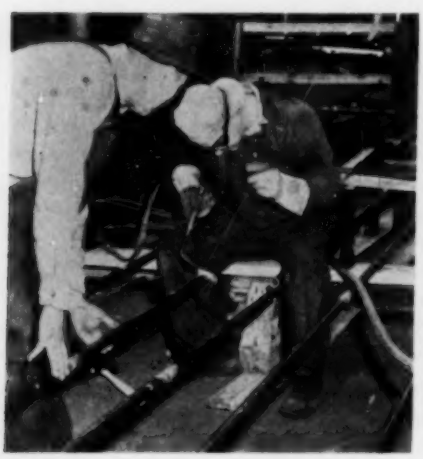

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Here's How to Cut

PIPING OPERATING COSTS

G. W. HAUCK, manager of engineering sales, Crane Co., Chicago, suggests some ways of reducing operating costs by making modest outlays for piping equipment to facilitate opening and closing valves. The examples are far from a complete listing of the opportunities, are merely intended to indicate a type of "thinking-through" which will produce economies in operating piping systems

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PLANT EXECUTIVES are intent these days upon exploring every available means of effecting economies in operations. The high unit cost of labor is susceptible to scrutiny even though the objective of lower costs develops an incentive for increased expenditures for equipment.

While this broad, overall statement could be applied to many phases of industrial operations, it can be narrowed down in this article to focus attention on piping alone and still develop some interesting possibilities for specific economies. Even a casual inspection of many piping systems under operating conditions will disclose opportunities for saving man-hours through the judicious application of auxiliary equipment, either automatic or otherwise. A detailed, analytical survey usually will pay greater dividends in savings. In either case, it is quite likely that reductions in labor costs will justify outlays for piping equipment.

A few observations and examples will serve to develop this theme and perhaps prove to be provocative in stimulating attention to piping systems by those who are responsible for operating costs.

Good design precludes the installation of all valves in the most convenient location for operation. Some valves must be put in places which are relatively inaccessible with relation to the normal level of operators. The amount of time which operators must spend in getting to such valves may cumulatively entail costs which should be challenged. The frequency of operation is, of course, pertinent in

Fig. 1—Addition of a chain wheel can save time lost in valve operation

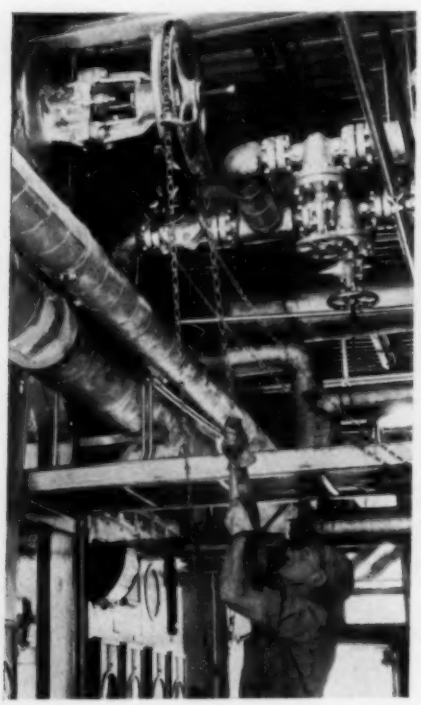
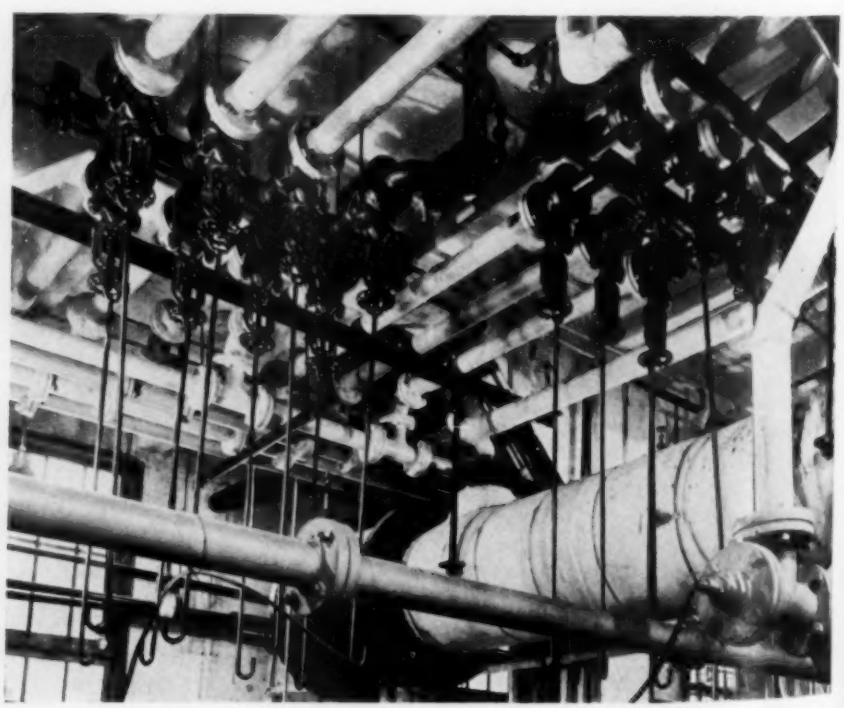


Fig. 2—Extension stems on overhead valves provide a means of operation at a lower level



almost anything which was available was installed if it would work

considerations of plans to save this time.

The operation of an ordinary valve in an elevated location may require the use of a ladder or stairs, or perhaps a catwalk. Many valves are often reached only by a roundabout path. The addition of a chain wheel, Fig. 1, can be a very practical solution to the problem of eliminating this lost time because it permits the operator to remain on his normal level. In other cases, an overhead valve, especially in the smaller sizes, can be equipped with an extension stem (Fig. 2) to provide a means of operation at a lower level.

The opposite condition—a valve below an operating floor or otherwise subnormal in elevation—presents an identical handicap in lost time for operation. Perhaps it is time which cannot be spent without neglecting something else. In some cases, absence from an operating floor creates a hazard or there may be some risk in getting at and in operating a valve which is difficult of access. For the smaller sizes of such valves, a simple extension stem may suffice; for larger valves, the addition of a floor stand with extension stem is indicated (Fig. 3).

The previous conclusions pertain to valves which must be operated either infrequently or at least with a frequency that is reasonable with relation to the operations being performed, the availability of manpower, and its cost. If such manipulation of valves is frequent to a point of burden, then consideration of mechanical operation is justified when seeking ways to reduce costs.

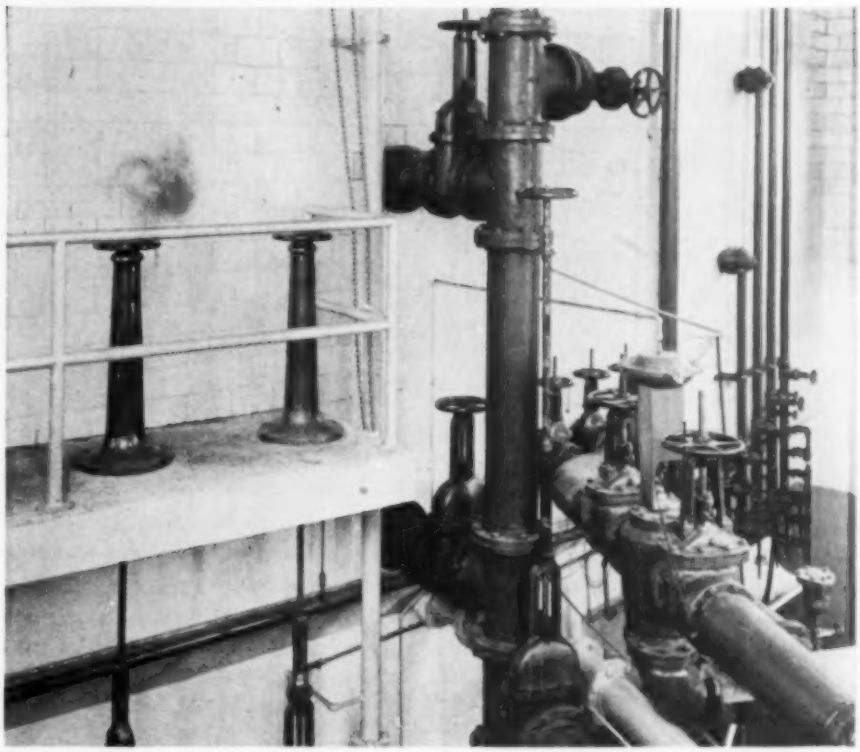


Fig. 3—For larger valves below the operating floor level, the addition of a floor stand with an extension stem is indicated

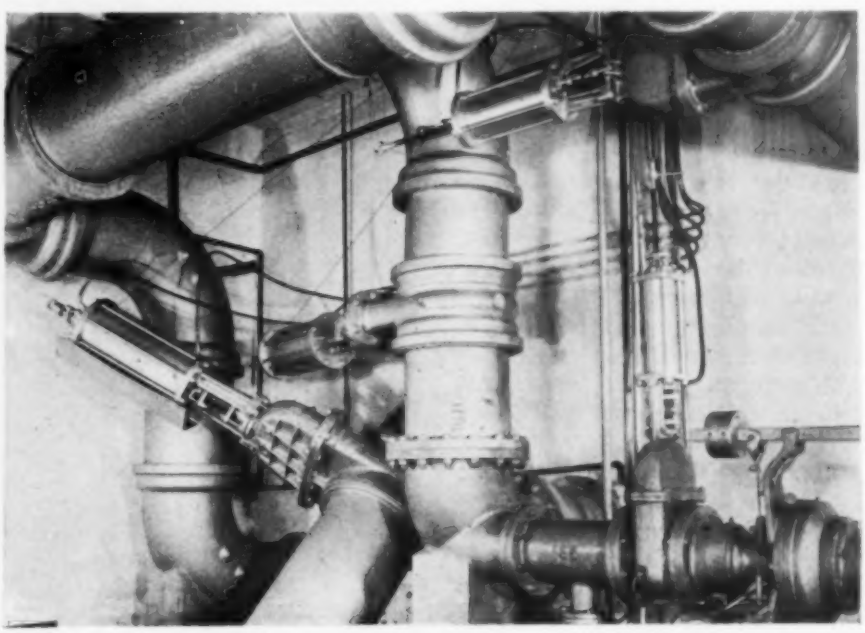
Mechanical Operation of Valves

Mechanical operation of remote valves can involve cylinder operation or motor operation—the latter being liquid, air, or electric motors (Fig. 4). The ultimate choice of one of the four types of mechanical operators suggested here would depend upon a number of individual conditions—relative costs, power available for operation, the time cycle for opening or closing, and the like. Space precludes a detailed discussion of these factors and the intent of this article is merely to indicate the direction of thinking in a survey to reduce costs.

When valves are remotely situated with respect to the normal location of personnel, a survey may disclose that the time consumed and the other disadvantages which stem from valve operation can well justify some type of motor operator, such as that shown in Fig. 5. Additional advantages may accrue through the ability to manipulate motor operated valves from any one of several points. The high unit cost of labor for operating remote valves may easily be sufficient over a period of years—perhaps less—to justify an outlay for motor operators, considering only the relative cost of the latter amortized over their normal life expectancy. The comparative savings alone can often justify such expenditures although the advantages of increased safety, speeding up operations, etc. should not be overlooked.

Is the Valve Open or Closed?—

Fig. 4—Mechanical operation of remote valves can involve cylinder operation or motor operation (liquid, air, or electric)



INDUSTRIAL VENTILATION

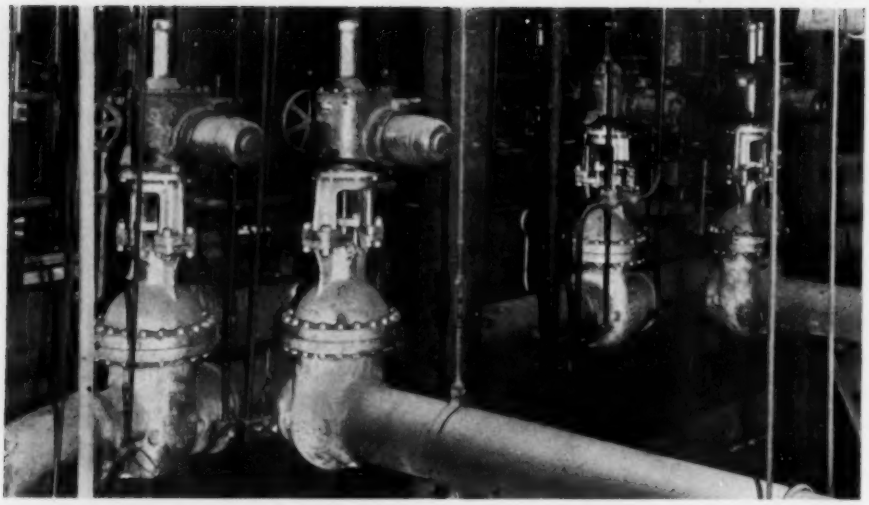


Fig. 5—When valves are remotely situated with respect to the normal location of personnel, a survey may disclose that the time consumed and the other disadvantages of valve operation can well justify some type of motor operator

This question is answered by a glance if the valve is in view and if it is of the outside screw and yoke or rising stem type. However, if it is a non-rising stem valve, time may be lost or confusion created in determining the position of the disc by manipulating the handwheel. Fig. 6 shows a simple, inexpensive indicator which can be applied to iron body valves in sizes 12 in. and smaller while in service.

Automatic Operation vs. Hand Operation

It is true that many operations in controlling or regulating flow can be performed by manual operation of valves. This is still common practice in many instances. While it might have been a sound procedure originally, present-day unit costs of labor may justify the substitution of automatic valves and reflect economies. A few examples will amplify this point.

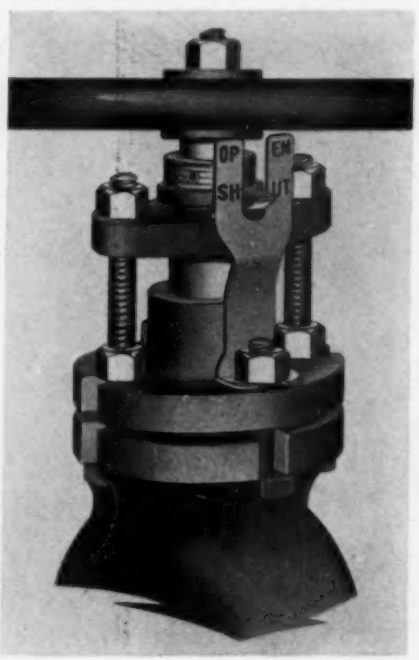
A conventional valve can be used to control flow to a tank or vessel which must be filled with liquid at intervals. However, if this operation is frequent or requires time to supervise the filling to proper level, hand regulation most likely should be discarded in favor of an automatic float valve. A wide variety of types, from simple direct float control to remote control, offers latitude in selecting such valves for specific situations.

Air can be vented from water or liquid lines by means of a hand operated valve which is usually installed at the highest point in the system where air will collect. This does not reflect the best practice generally and might be a relatively expensive item or a neglected task which could justify the installation of an automatic air vent.

Similarly, it is possible to operate manually a valve periodically to remove condensate, yet the economy resulting from the installation of an automatic steam trap is seldom disproved.

The past few years of war and postwar witnessed shortages that necessitated the installation of many substitute materials or other improvisations which now may be adding a considerable burden in maintenance costs. In emergencies, almost anything which was available was installed if it would work. This was understandable and sufficed for pipe lines which were intended as temporary or semi-permanent. Many, however, have continued in more or less permanent reconversion service, and hence should be checked for needed rehabilitation—especially if modernizing will effect economies.

Fig. 6—A simple, inexpensive indicator such as this one for non-rising stem gate valves saves time by showing at a glance whether a valve is open or shut



Reduce Maintenance Costs

Perhaps most typical of the ills existing in the improvised piping of the recent years is the misapplication of valves. Because shortages existed, it was understandable and condoned when improper types of valves were installed. Their use, however, may be adding to costs stemming from avoidable maintenance and inefficiency. This cannot be justified now that valves are readily procurable in proper types for individual services.

Another common fault exists in the improper suspension of piping due to expedients adopted in emergency construction during shortages. Without adequate support, piping (of its own weight plus the weight of the fluid) can strain joints to the point of leakage, distort valve seats, and otherwise contribute to maintenance costs. A modest outlay for suspension materials will effect reductions in costs of operation.

If periodic cleaning or overhauling of automatic devices, valves, or equipment is caused by the presence or accumulation of dirt or foreign matter in piping, the installation of a sediment separator may reduce maintenance costs.

The suggestions contained in the foregoing discussion can be applied effectively to the rehabilitation or modernizing of existing piping installations or to new construction. Further, the examples are far from a complete listing; they are merely intended to indicate a type of "thinking-through" which will produce economies in operating piping systems. Piping varies considerably in individual plants . . . in its character and in its operation. The method of searching for possible reductions in operating costs, therefore, cannot be expressed in single syllables for it is compounded of many variables and individual characteristics.

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INDUSTRIAL VENTILATION

How to Figure Fog and Vapor Removal from Tanks and Vats With Natural Draft System

ROBERT C. SORONEN, chief engineer, Cloverland Contracting Co., contractors and engineers, Iron River, Mich.—whose previous article on industrial ventilation in the April issue met with an enthusiastic response—writes this month on the use of direct vertical stacks for removal of fog and vapor from tanks and vats as used in industrial processes. This gravity or natural draft system is applicable with vapor laden air or gases lighter than air, he says. An example quickly shows the method of figuring such a job

ELIMINATION OF fog or vapor laden air from such industrial sources as tanks and vats can frequently be accomplished by means of direct vertical stacks fabricated from matched lumber (treated inside and out with a coat of asphaltum or bitumastic paint), or from galvanized or black iron or other metals.

Known as the gravity or natural draft system, this method is not recommended for the removal of dust laden air unless the dust particles are very minute in size and are buoyant in high temperature air. This system is applicable for the removal of vapor laden air or gases lighter than air (low density gases).

Locating and Installing Stacks

If the vats or tanks are of the totally enclosed type, the exhaust stacks must be installed so that the bottom or inlet is flush with the cover or top of the vat, and the stack or stacks (depending on vat size) should be centrally or proportionally located for best results, as indicated in Fig. 1.

Vats or tanks installed on or above the floor usually require one or more sides open for dipping or quenching operations and therefore demand precautionary measures not required with totally enclosed vats. Wherever possible, three sides should be enclosed to prevent cross-drafts which would otherwise nullify the purpose of the stack—which is to exhaust vapors. Fig. 2 shows an example.

Unlike forced exhaust systems and their outlets to atmosphere, gravity vent stacks should extend a minimum of 2 ft above the high point of the roof or adjoining building, whichever is the higher, in order to use prevailing winds advantageously as the motive force in the elimination of fog, vapor, and fumes.

Each gravity exhaust stack should be equipped with an approved and guaranteed ventilator of either the stationary or revolving type, several different types of which are commercially available. These ventilators are usually rated in cubic feet per minute or cubic feet per hour. Generally, a vent is selected having a neck area equal to the stack area to which it is connected.

In the author's experience, exhaust or vent stacks for gravity or natural draft systems are limited to velocities not exceeding 250 fpm as a maximum or approximately 4 fps.

The volume of air to be exhausted (cfm or cfh) can be determined in the same manner as described and explained in the author's previous article on industrial ventilation in the April HPAC.

The unit volume of air for exhaust purposes is based on the removal of 200 to 225 cfm per sq ft of vat area. This area does not necessarily mean total vat area (such as 180 sq ft for a vat 20 ft x 9 ft) but rather the total area of opening by which the vat or tank is loaded or unloaded.

How to Figure a Job

As an example, assume a vat 20 ft x 9 ft, totally enclosed but provided with two 9 ft x 4 ft access doors, one at either end, for loading and unloading. It is to be noted that only one door, or a total area of 36 sq ft, need be considered, as the unloading door will be closed when the loading door is open. Find the volume of air to be exhausted by gravity, the area or size and number of stacks, and the size and type of ventilators.

Solution

1) 9 ft x 4 ft = 36 sq ft of surface area.

2) 225 cfm per sq ft x 36 = 8100 cfm exhaust.

3) 8100 cfm/250 fpm = 32.4 sq ft stack area (250 fpm is maximum velocity for gravity stack).

3) Use one or more vent stacks totaling 32.4 sq ft.

4) Select one or more (depending on number of stacks) approved ventilators or exhausters having a capacity equal to or greater than 8100 cfm or 486,000 cfh.

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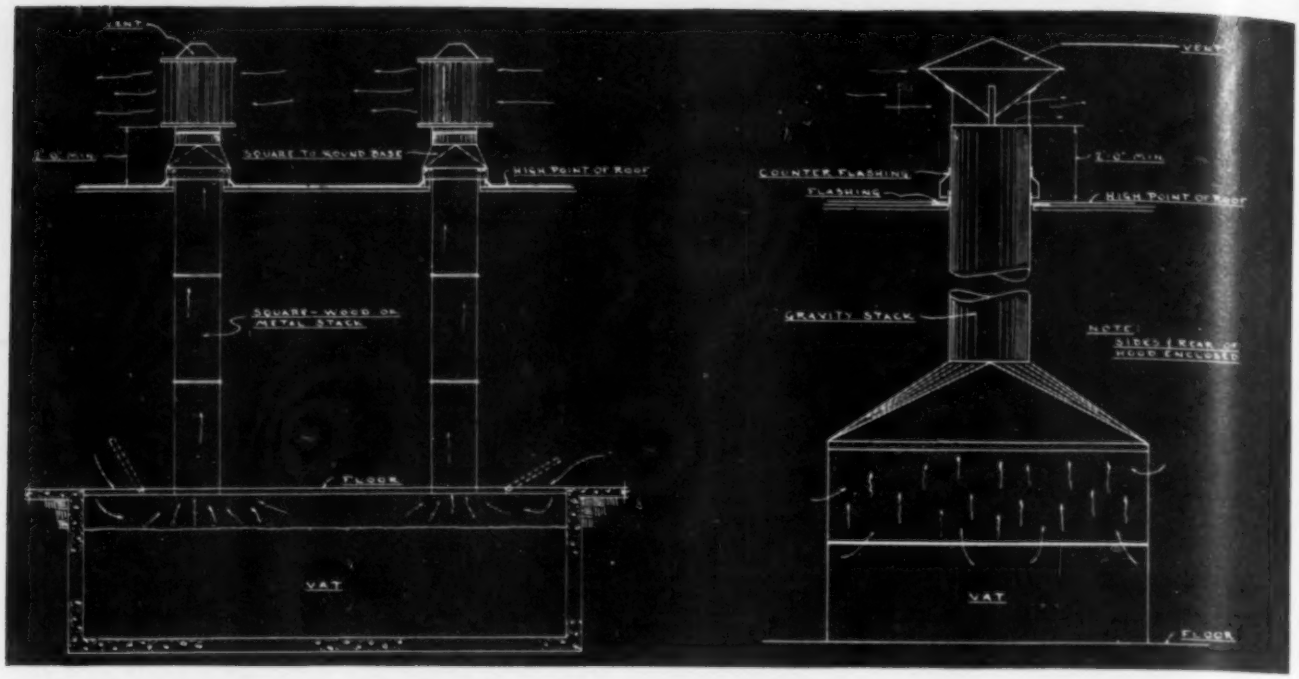


Fig. 1 (left)—The stack or stacks should be centrally or proportionally located for best results. Fig. 2 (right)—Wherever possible, three sides of the vat or tank should be enclosed to prevent cross-drafts which would otherwise nullify the purpose of the stack—which is to exhaust vapors to the atmosphere.

It is evident that, due to the large stack size, in cases where floor space is at a premium a gravity system may not be as applicable as a forced exhaust system—although generally vats of the recessed type are provided with guardrails, thereby eliminating the covered surface as productive floor area.

Be Sure to Supply Make-Up Air

A very important phase of the design of any exhaust system—either forced or gravity—is the provision of tempered make-up air to supplement that air lost to the atmosphere.

I have found that most generally when an engineer is called in by a plant owner or operator on a ventilation problem, he (the owner or plant operator) is well aware that air must be removed. But it is usually very difficult to convince him that during the winter months, when windows and doors are closed, heated or tempered air in almost equal proportions to the amount exhausted must be provided.

The situation becomes alarming when he is told that in exhausting 8100 cfm his boiler will be taxed an additional 527,310 Btu per hr (@ 0 F entering air and 60 F inside design) or 16 boiler horsepower. At this point in the discussion, the owner throws up his hands and is ready to forget the whole matter.

When this crisis arises, a gentle reminder to the effect that most states have enforced ventilation laws and an explanation (in the layman's scope of understanding) of basic principles or "give and take" in the science of heating and ventilating, coupled with a discussion of the numerous advantages of a first-class system, generally results in a sold job.

CALL DOCTOR TO TREAT SOLVENT ILLNESS

Workers handling volatile solvents should be instructed to report promptly any feeling of discomfort, says the Safety Research Institute. Dizziness, headache, eye difficulties, weakness, nausea, or stomach upset may be due to other causes, but they can also result from inhaling solvent vapors and may serve as an early warning that medical attention is required. Neglect of such warnings may lead to serious illness.

In one instance, a man spent several hours cleaning some equipment with a substantial quantity of solvent in a basement room where there was little ventilation. Several times he felt a little dizzy and went outdoors for a few breaths of air and to get away from the odor. Since this made him feel better he said nothing about his discomfort but kept at the job until it was finished. The next day he felt much worse and by the time he consulted a doctor he was seriously ill and had to be sent to a hospital.

In another case, a man entered a solvent tank to clean it, and made the serious error of entering the tank without a respirator. He became ill from the heavy solvent fumes and, instead of reporting to a physician, tried to treat himself by taking a few nips of hard liquor. A doctor would have told him that alcohol intensifies the effects of solvents on the body. His self-treatment led to serious illness.

Some persons are especially susceptible to solvent illness, and even a rather mild exposure (degreasing a motor or wiping metal parts with a solvent-saturated cloth, etc.) may lead to illness. For this reason, early signs of discomfort should not be overlooked even when it seems unlikely that much solvent has been inhaled.

While inhalation of solvent vapors is the most frequent source of solvent illness, it sometimes happens that the liquid is swallowed by mistake. The person should be made to vomit and a physician should be called at once. Also, since skin contact with solvents sometimes leads to dermatitis, persons who develop skin difficulties after working with these liquids should report to a physician.

Axial Flow Duct Fans Solve *Tunnel Ventilation Problem*

GEORGE G. NASH, sales engineer, L. J. Wing Mfg. Co., New York, describes an installation of two axial flow fans for ventilating the Consolidated Edison Co.'s Hell Gate-Astoria tunnel, which carries steam, gas, electric, oil, and air lines. Abnormally high temperatures in the tunnel might cause leaks in the gas mains due to expansion and contraction, or breakdown of insulation on electric cables. Adequate tunnel ventilation is thus essential

EXPANSION OF the Astoria, Queens, gas generating plant of the Consolidated Edison Co. of New York made necessary additional steam supply. Rather than add steam generating facilities to the Astoria plant, it was found that the required steam could be spared from the company's generating plant at Hell Gate.

This steam is piped through an existing tunnel under the East River used to carry manufactured gas between Astoria and the Bronx. This tunnel, built in 1914, is 4662 ft long and the shafts are 230 ft and 250 ft deep. It carries two 72 in. diameter gas mains, with a maximum capacity of 50,000,000 cu ft per day, as well as electric cables, an 8 in. oil line, and a 6 in. air line. A 12 in. steam line was installed having a capacity of 180,000 lb per hr at an entering pressure of 280 lb and a leaving pressure of 210 lb.

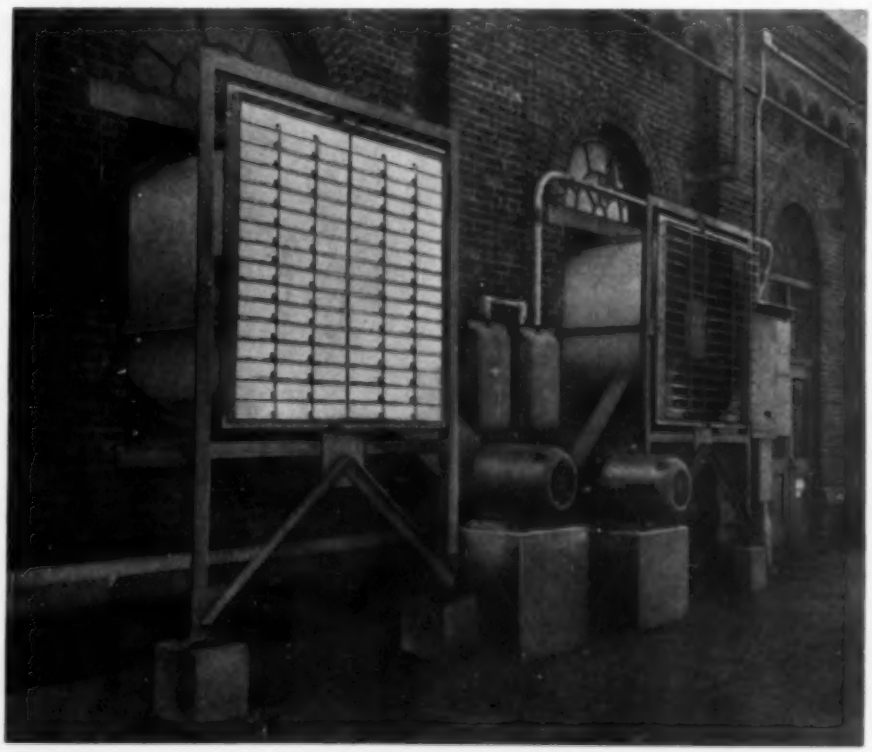
Why Ventilation Is Essential

The tunnel had been adequately ventilated by three exhaust fans with a total capacity of 35,000 cfm against ½ in. static pressure, the fans being located in the roof of the Astoria head house. However, it was feared that the addition of the new steam main, even though well insulated, would cause abnormally high temperatures in the tunnel—which might cause leaks in the gas mains due to expansion and contraction. Furthermore, it could cause breakdown of insulation on the electric cables, rated at an ambient temperature of 104 F, unless capacity were reduced.

Since 104 F is the allowable limit of temperature, it was calculated that 120,000 cfm of air would be required to ventilate the tunnel on a hot summer day with an outside temperature of 95 F. With 120,000 cfm as maximum, the tunnel velocity would be approximately 1100 fpm. Thus, a static pressure of 1½ in. was specified at the fan. The additional exhaust fans, like the original fans, were to be installed on the Astoria end, pulling the fresh air down the Hell Gate shaft through the tunnel and up the Astoria shaft.

Axial flow fans were selected, as they could be installed without adding an extension on the existing head house. It was calculated that two axial flow exhaust fans of 60 in. diameter could develop 60,000 cfm apiece and could be installed in two of the 63 in. wide windows. No floor space would be occupied, and the maximum capacity required would be met; with the additional advantage that in cooler weather, one fan would probably be sufficient to maintain the required temperature in the tunnel. To supply the 60,000 cfm against 1½ in. SP, it was estimated that the required speed would be 1150 rpm with a maximum of 25 bhp and a sound rating of 88 decibels.

Self-closing shutters of extra heavy construction with aluminum



The two 60 in. axial flow fans, installed in the windows of the head house, are driven by motors through enclosed v belts. This view shows the exhaust ends

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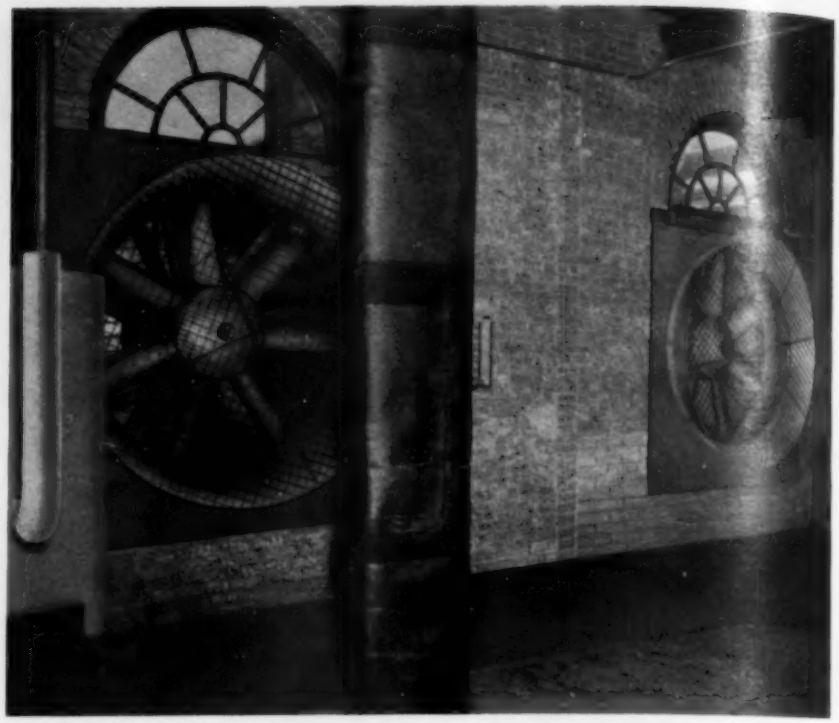
This interior view of the head house shows the fans with their inlet cones and screens, and the radial straightening vanes beyond the fan wheels



leaves and positive spring return were mounted directly on each fan discharge. In addition to keeping out rain, snow, cold, and insects when either fan is inoperative, this avoids leak-back through the idle fan.

The installation comprised two vaneaxial duct fans, each cased in a cylinder with an inside diameter of 60 in. and a length of 45 in. An inlet cone with a protecting screen is bolted to one end of the casing. The fans are of fabricated steel construction, each comprising seven hollow blades of airfoil design welded to a 20 in. diameter hub which has a rounded nose for streamlined air entry. The fan impeller shaft is mounted on two pillow block bearings, grease lubricated from the outside of the casing, with the fan pulley on the opposite end of the shaft. Shaft, bearings, and pulley are mounted in an inner cylinder which, in turn, is supported by eight radial vanes. These vanes also act as air straighteners to produce true axial flow of air.

Guarding Against Sparks

The fact that the tunnel carries two gas mains, with the possibility of leaks, dictated the use of nonferrous tips for the fan blades and a zinc spray was applied to the fan race. The v belts used for the fan drive, although completely enclosed and separated from the air stream, are likewise nonsparking. Motors suitable for outdoor use were furnished by Consolidated Edison and were mounted externally and separately from the fan units.

Performance of the Fans

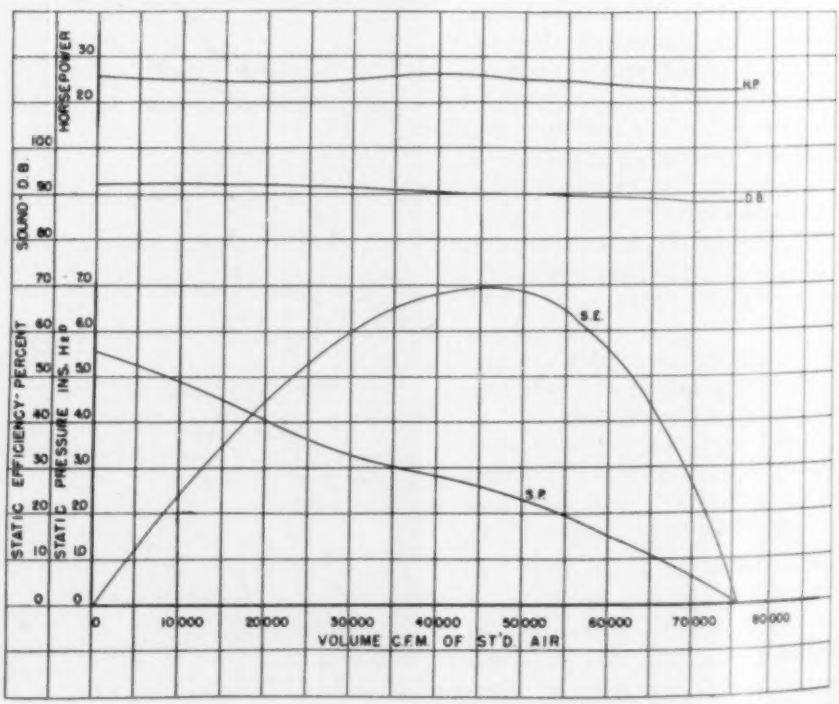
Performance has been found to be 60,000 cfm at 1½ in. SP at 1030 rpm, requiring 24 bhp at the condition point with a sound rating of 89 decibels. The rising pressure-volume curve shown in the accompanying chart insures fan stability over the entire range from free air delivery to maximum shutoff. Also, the flat horsepower characteristic prevents the motor overloading at any point of operation.

The sound rating of 89 decibels is of relatively low frequency and, with a housing development only 400 ft away, there has been no objection on the part of the tenants even on summer nights with bedroom windows wide open. A sound absorbing box to be placed over the fan discharges was found unnecessary, and this cost was saved.

The installation of the two new axial flow fans enables flexibility of ventilating capacity. In effect, there are five fan units, including the three original exhaust fans. These can exhaust up to 35,000 cfm without calling on the axial flow fans. If further cooling is required, one of the axial flow fans can be thrown in with its capacity of 66,000 cfm at 1 in. SP, while in very hot weather the two axial flow fans, operating in parallel, can remove the total of 120,000 cfm against 1½ in. SP.

This application is an interesting example of the place of the axial flow fan in industrial ventilation.

The rising pressure-volume curve insures fan stability and the flat horsepower characteristic prevents motor overloading



Analysis of Air Conditioning in Baltimore Area Indicates Trends

GAYLE B. PRIESTER, air conditioning engineer, Consolidated Gas Electric Light and Power Co. of Baltimore, presents data on installations in that area to answer the questions: Who buys air conditioning? Who needs air conditioning? Where is the best market for air conditioning? . . . Many air conditioning contractors and others have asked for such data, which are conveniently presented in a series of tables. Information on the weather, and on power consumption for air conditioning, is included

WHO BUYS air conditioning? Who needs air conditioning? Where is the best market for air conditioning?

The author has received requests for much of the information contained herein from air conditioning contractors and others in many cities. It is thought that the data are of general interest and use.

The figures given here pertain to Baltimore and the immediate surrounding area. The population covered is estimated to be about 1.4 million. The city of Baltimore is an active seaport and has many diversified industries. There is a definite need for air conditioning, since it gets hot and sticky in the summer—though seldom for prolonged periods of time. Selling is not easy—but is it anywhere? Considering everything, the Baltimore market is not too untypical or nonaverage. But the reader is warned not to jump at conclusions.

Restaurants, Taverns Lead in Number

A tabulation of air conditioning installations in the area, classified as to application, is given in Table 1; it shows that the greatest number of air conditioning installations during the year 1948 was in restaurants and taverns, followed by offices, and then by miscellaneous stores, and that these three classifications have been at the top for each year shown, but that their order or sequence has changed.

As for 1949, so far, restaurants and taverns still rank first, with stores second and offices third. It appears that the easiest market consists of restaurants and taverns while the largest potential commercial market lies in offices and stores because there are so many more of them. Selling efforts can still be well spent in all these fields. It has been noted, and this is a good sales point, that most chain stores in the drug store, shoe store, dress shop, jewelry store, candy store, and (recently) bakery store classifications are practically all air conditioned.

The greatest total horsepower for air conditioning has been installed in department stores, offices, and theaters in that order, but in recent years the most hp has been in offices, restaurants and taverns or department stores. This indicates the present trend in Baltimore. A further breakdown of store installations reveals an increasingly larger number of candy, bakery, and other food store installations in recent years. The hp figures used throughout refer to the total hp involved in each installation. The refrigeration tonnage involved would be from 10 to 20 percent less in most cases.

Size Breakdown of Installations

A breakdown of the size of installation is given in Table 2. The 5 ton installation definitely has led the field in recent years compared with

Greatest number of Baltimore installations in recent years have been made in restaurants, cafeterias, and taverns. The evaporative condenser shown here was recently installed to replace a water cooled condenser

Table 1—Air conditioning installations in the Baltimore area by application

Classifications	During 1946 No.	During 1946 hp	During 1947 No.	During 1947 hp	During 1948 No.	During 1948 hp	Total as of 12/31/48 No.	Total as of 12/31/48 hp
Residential:	2	7	6	27	5	19	55	200
Commercial:								
Apartments (owner installed)			1	2	1	6	3	18
Banks	3	59	3	59	10	172	41	982
Barber & beauty shops	5	27	7	30	4	24	51	290
Broadcasting studios			6	202	1	57	12	340
Clubs							2	14
Funeral homes	5	50	6	48	3	25	39	348
Hospitals			3	82	4	56	20	310
Hotels	5	94	3	22	2	156	13	429
Offices	76	778	103	1262	74	1411	408	8564
Public buildings	1	50					16	969
Recreational	8	166	5	191	5	83	35	1131
Restaurants & taverns	73	944	81	1067	84	1054	419	5641
Stores, department	13	2498	8	403	8	880	83	9533
Stores, drug	12	108	22	145	12	226	121	1242
Stores, miscellaneous	80	971	87	836	65	793	373	4481
Theaters	12	727	10	502	13	575	131	7886
Other commercial	4	231	21	407	10	1744	58	2782
Industrial:								
Candy manufacturing			2	5	1	26	8	148
Drugs & chemical manufacturing	1	28					3	182
Printing and lithographing			3	49			12	234
Textile manufacturing	1	27	1	5	2	402	5	459
Metal working	2	320					5	400
Food processing			3	25	1	5	5	33
Other industrial	9	474	10	190	10	237	88	3112
Total contract installations	312	7559	391	5559	315	7951	2006	49,728
Unclassified self-contained room cooler unit sales	238	160	493	312	711	427	3863	2,903
Grand total	550	7719	884	5871	1026	8378	5869	52,631

Table 2—Size trend of contract air conditioning installations in Baltimore area

Total Hp per installation	Total number of installations 1946	1947	1948	Total as of 12/31/48
Under 3.0	4	17	3	428
3.0 to 4.99	51	83	39	
5.0 to 7.49	91	120	86	1124
7.5 to 9.99	24	26	33	
10.0 to 14.9	50	53	46	
15.0 to 24.9	30	33	41	
25.0 to 49.9	33	34	42	365
50.0 to 74.9	14	15	12	
75.0 to 99.9	5	4	1	
100 to 500	8	6	10	— 80
Over 500	2	0	2	— 9
	312	391	315	2006

Table 3—Comparative number of air conditioning installations in Baltimore area

	Hp Range 3 to 4.99	5 to 7.49	7.5 to 9.99	10.0 to 14.9	15 to 24.9	25 & up
January 1946	2	3	1	1	1	3
January 1947	—	2	—	1	1	4
January 1948	2	3	2	1	4	6
February 1946	1	4	2	3	—	5
February 1947	1	3	—	2	3	3
February 1948	4	6	2	2	2	4
March 1946	5	5	2	5	5	3
March 1947	2	10	1	8	2	4
March 1948	4	5	1	1	5	6
April 1946	2	5	2	—	3	9
April 1947	9	8	—	2	3	3
April 1948	1	12	5	4	4	1
May 1946	2	9	2	10	4	4
May 1947	3	9	4	4	5	4
May 1948	8	12	3	5	6	13
June 1946	10	19	3	2	1	8
June 1947	10	15	3	10	2	4
June 1948	3	7	5	8	4	7
July 1946	3	14	1	6	3	5
July 1947	11	14	2	3	5	1
July 1948	4	11	3	4	2	1
August 1946	4	4	3	4	1	4
August 1947	3	7	5	7	2	3
August 1948	3	7	1	2	2	3
September 1946	3	4	2	3	2	2
September 1947	3	5	2	1	2	4
September 1948	—	5	—	3	1	2
October 1946	2	3	3	1	1	3
October 1947	1	3	—	3	1	6
October 1948	1	2	2	1	2	1
November 1946	—	2	—	2	1	2
November 1947	1	5	2	—	1	6
November 1948	—	2	1	1	—	1
December 1946	—	2	—	—	1	4
December 1947	1	6	1	2	1	2
December 1948	1	2	—	3	1	1

Note: All sales are not included in this table, but the monthly figures are comparable.

the number of installations of other nominal capacities. The number of 3 ton installations ranked second, with the 10 ton installations third in 1946 and 1947; but there were more larger installations in 1948.

There still remains a good market for the 3 and 5 ton "dressy" package units as store or office coolers and for the 7½ and 10 ton remote package units for use with ductwork. The introduction of 7½ and 10 ton package units with six row cooling coils and coil bypass sections makes available satisfactory equipment for taverns and restaurants. Also, the package units containing evaporative condensers are ideal for many applications.

When Are Contracts Obtained?

The time of obtaining the air conditioning contracts is given in Table 3. Most of the smaller installations are sold in June, with July second and May third for both the 3 and 5 ton sizes, while May is second for the 7½ and 10 ton systems. May ranks first for the 15 ton and larger sizes. The percentages for each month of the total annual in-

Table 4—Monthly percentage of annual installations of air conditioning in Baltimore area

	1946 No.	1946 hp	1947 No.	1947 hp	1948 No.	1948 hp
January	5.1	3.6	4.1	4.6	7.3	17.9
February	8.6	13.1	5.2	9.4	8.2	6.1
March	6.7	5.1	7.5	11.5	9.0	20.9
April	13.0	13.5	9.9	8.7	13.9	6.9
May	12.6	18.4	11.6	7.4	16.3	21.0
June	14.2	7.6	15.7	10.9	14.3	10.2
July	14.9	7.4	16.4	7.9	10.2	3.7
August	7.1	4.2	7.5	10.4	7.3	4.0
September	6.7	3.3	6.8	9.2	4.5	2.9
October	5.9	3.1	6.5	8.9	3.7	2.2
November	2.4	2.4	4.4	7.3	2.0	1.6
December	2.8	18.3	4.4	3.8	3.3	2.6
	100.0	100.0	100.0	100.0	100.0	100.0

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stallations for eacn year for the past three years are shown in Table 4. July ranked first in 1946 and 1947, with May being first in 1948 for the number of installations. With reference to the horsepower installed, May was first in 1946 and 1948, and March was first in 1947.

It is suggested, therefore, that sales efforts on the remote installations with ductwork be concentrated in the winter and spring months, leaving the installation and service men more free in the early summer for the package equipment which can usually be installed more quickly.

Room cooler installations are not included in Tables 2, 3, and 4. However, an analysis of the room cooler sales as reported by the distributors for sales in this territory is given in Table 5. No breakdown as to the time of sale or the application of the units is available. The comparatively low number of ¾ hp units for 1948 was due to there being few available units that could meet starting current requirements at 120 volts.

What's the Operating Cost?

Since most commercial customers purchase air conditioning because of the economics involved, one question of great interest is: How much will the operating cost be? This is affected by the weather, the frequency and duration of the design load, and the total number of hours of use.

As to the weather in Baltimore, Table 6 shows the breakdown of the degree hours that the dry bulb temperature was above 75 F. In other words, 75 was subtracted from the Weather Bureau hourly dry bulb reading and the differences added to give the total for each month. Table 7 shows the breakdown of the degree days that the wet bulb temperature was above 65 F. Weather Bureau wet bulb readings were taken only four times daily, and the data in Table 7 were obtained by subtracting 65 from the higher of the 1:30 or 7:30 p.m. readings and the differences added to give the total for each month.

In general the air conditioning season in Baltimore is from May 15 to October 15. The five year average figures for both the dry bulb and wet bulb temperature data indicate that over one-half of the air conditioning weather comes in July and August, with slightly more occurring in July. About one-fifth comes in June and one-seventh in September. Then come May, October, and April.

Power Consumption—A study of the electric power consumption for air conditioning for various types of establishments has also been made. It was noted that the power consumption during the last two years has changed somewhat from that during the preceding years, and it is thought that the more recent figures are more normal than those for the war years.

A summary of the data obtained

Table 5—Room cooler sales in Baltimore area

	1/3 hp	½ hp	¾ hp	1 hp	1¼ hp	1½ hp	Total
1946	—	91	140	2	—	5	238
1947	19	228	237	—	—	9	493
1948	—	493	191	1	11	15	711

Table 6—Degree hours above 75 F, Baltimore area

1944		
January	—	
February	—	
March	—	
April	28	0.2%
May	1358	10.9
June	2363	18.9
July	4126	33.0
August	3492	28.0
September	1040	8.3
October	83	0.7
November	—	
December	—	
Total	12,490	100.0
1945		
January	—	
February	—	
March	384	3.9%
April	89	0.9
May	291	2.9
June	3173	31.9
July	2260	22.8
August	2290	23.1
September	1360	13.7
October	75	0.8
November	3	
December	—	
Total	9925	100.0
1946		
January	—	
February	—	
March	20	0.2%
April	81	1.0
May	496	6.1
June	1912	23.4
July	2791	34.2
August	1451	17.8
September	1105	13.6
October	293	3.6
November	5	.1
December	—	
Total	8154	100.0
1947		
January	—	
February	—	
March	—	
April	173	1.8%
May	665	7.1
June	1197	12.8
July	2182	23.3
August	3308	35.3
September	1547	16.6
October	286	3.1
November	—	
December	—	
Total	9358	100.0
1948		
January	—	
February	—	
March	136	1.5%
April	39	0.4
May	419	4.5
June	1770	18.9
July	3278	35.1
August	2653	28.3
September	1029	11.0
October	30	0.3
November	—	
December	—	
Total	9354	100.0

Table 7—Degree days, wet bulb above 65 F, Baltimore area

1944		
January	—	
February	—	
March	—	
April	—	
May	63	8.6%
June	145	19.6
July	216	29.2
August	199	27.0
September	106	14.4
October	9	1.2
November	—	
December	—	
Total	738	100.0
1945		
January	—	
February	—	
March	3	0.4%
April	6	0.8
May	24	3.1
June	184	23.8
July	231	29.9
August	171	22.1
September	152	19.6
October	2	0.3
November	—	
December	—	
Total	773	100.0
1946		
January	—	
February	—	
March	—	
April	—	
May	46	7.4%
June	131	21.1
July	203	32.8
August	126	20.3
September	98	15.8
October	15	2.4
November	1	0.2
December	—	
Total	620	100.0
1947		
January	—	
February	—	
March	—	
April	—	
May	59	7.3%
June	113	14.0
July	192	23.9
August	266	33.1
September	130	18.6
October	25	3.1
November	—	
December	—	
Total	805	100.0
1948		
January	—	
February	—	
March	4	0.5%
April	—	
May	42	5.6
June	154	20.7
July	236	31.7
August	216	29.0
September	92	12.4
October	1	0.1
November	—	
December	—	
Total	745	100.0

Table 8—Power consumption data, 1947-48

Installations No.	Class	Hp range	Annual kwhr/hp Range	2 yr avg.
3	Beauty shops	5-8	511-745	602
4	Cafeterias	11-21	770-1365	1124
2	Dress shops	5-45	710-1085	748
6	Drug stores	9-12	726-2101	1215
3	Jewelry stores	5-9	785-1180	900
4	Large offices	45-60	490-1018	547
3	Small offices	all 5.5	316-580	477
4	Ten cent stores	40-140	344-470	403
6	Theaters	35-60	445-1300	700
4	Night clubs	15-47	683-1190	989
2	Shoe stores	all 3.5	485-782	663
4	Restaurants	12-36	850-1870	1550
3	Funeral parlors	10-18	148-249	207
2	Residences	5-10	205-295	250
3	Recreation spaces	25-65	276-651	472
			Weighted avg.	790

Table 9—Average percent of annual totals

	Apr.	May	June	July	Aug.	Sept.	Oct.
Electric power consumption	—	5	16	28	28	18	5
Degree hours above 75 F	2	6	21	30	26	13	2
Degree days, WB above 65 F	—	6	20	30	26	16	2

is presented in Table 8, and attention is called to the wide variation in the figures for different applications. This indicates that the restaurants, drug stores, and cafeterias use more electric power per installed horsepower than other types of customers. The chief reason for this is that their main load components are people and lights, and they are open many hours. Funeral parlors use their cooling equipment the least, with residences a close second. In estimating the power consumption for any particular customer the hours of occupancy must be determined and good judgment applied in making the the necessary assumptions.

Table 9 shows by months the average percent of annual totals for electric power consumption and for weather data. A fairly close correlation is noted though the power consumption figures tend to lag behind the weather figures.

Water Usage—Water consumption data also are needed to estimate operating costs. This information can be approximated from the equipment manufacturers' data and the estimated, equivalent, full load, operating hours for the installation. In communities where the water supply or sewer system is critical, most installations use water saving equipment. An analysis of the Baltimore territory for 1948 shows that water-wasting equipment was installed on only 134 of the installations involving 1371 hp, or on only 16.4 percent of the total hp. In other words, air cooled condensers or water saving devices were used with over 80 percent of the equipment hp installed for air conditioning in Baltimore in 1948.

An increasing number of bakery and food store air conditioning installations have been made lately

A large potential commercial air conditioning market lies in offices and in stores

REPORTS SALES DATA, PROFIT

Net profit of Carrier Corp., a leading manufacturer of air conditioning, refrigeration, and industrial heating equipment, for the 12 months ended April 30, 1949, was $2,083,320 as compared with $2,349,697 in the preceding similar period.

Completed sales totaled $51,198,786. The comparable figure for the 12 months ended April 30, 1948, was $55,050,376. New orders were booked in the amount of $48,634,081. The total for the preceding 12 months was $46,139,159.

On April 30, 1949, the corporation had a backlog of unfilled orders amounting to $20,174,779 as compared with $23,304,757 a year earlier.

In commenting on current earnings and business, Cloud Wampler, president of the corporation, said that new orders booked during the first six months of fiscal 1949 were only 9 percent below those of the corresponding period a year ago.

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SAM LEWIS' PAGE

Informal comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, member HPAC's board of consulting and contributing editors

What Causes Smoky Film on Store's Show Window?

In modernization of some stores, the window bulkheads at the backs of the show windows were removed to give an open display to the interior. Since then, the insides of the windows gather a "smoky film." Mr. Lewis explains the probable cause, suggests how to correct the difficulty

WE HAVE THE following inquiry from a friend and reader of this page whose building is served by natural gas:

"In modernizing our stores, we removed the window bulkheads at the back of our show windows to give an open display to the interior of the stores. Since we have done this, the insides of our windows gather a smoky film on them which apparently is caused by the gas heat we use from a pipeless furnace. Is there any way this condition can be overcome?"

It is doubtful whether the "smoky film" is anything but condensed moisture which causes the inside of the show windows to be wet or viscous, so that the dust, ever present in city air, tends to collect on the glass. People sometimes fail to remember that when gas is burned, a result of the chemical thermal process is water vapor or invisible steam.

Possibly, in the present case, the furnace is in a basement which receives very little air supply (if any) from outdoors. It is also possible that if the conventional type of pipeless furnace is used, the device comprises a large cast iron stove-like structure originally designed to burn coal and fitted with a conversion gas burner.

The "pipeless" means to me that the stove has two concentric jackets and that there is a composite register or grille with warm air flowing upward to enter the store through the central part of the grille and with relatively cool air flowing downward through the outer part of the grille. Thus there is no inlet to the furnace for new air from outdoors and the air within the store circulates around and around.

If the furnace is a modern one and designed for gas, it has a draft hood in the breeching between the furnace and the chimney, designed to receive a copious volume of air from the furnace room. This air intake has been found necessary to carry away the water vapor that results from combustion of gas. Without it, the moisture condenses inside the chimney and quickly damages the masonry and rusts the metal. If the furnace room has no direct intake for air from outdoors, then the draft hood cannot serve its desired purpose.

People experienced with gas burning furnaces or boilers always hope to connect them with chimneys that have moisture resistant linings. The gas burning furnace served by an ordinary brick and mortar chimney eventually destroys the chimney because water collects in the masonry, then freezes, and the soft brick and the mortar must flake off.

Our friend will aid correction of his show window trouble if he sees to it that the following items are incorporated:

1) There must be a draft hood.
2) There must be an outside air

inlet to the furnace room so that air may enter to dilute the gases of combustion within the breeching and the chimney.

3) An intake for some outside air to the furnace casing will be found helpful, so as to provide a definite air change to reduce the relative humidity of the general air in the store. All lavatories and every floor scrubbing and each customer add moisture to the air. The pipeless furnace merely circulates the same air around until the relative humidity of the air increases to the extent that the cool glass of the show windows must cause the air near the glass to reach the dew point temperature. The dew falls on the glass just as it does on the sidewalk or grass on a summer evening.

4) A small electric fan blowing air against each show window has been found helpful in moving away from the glass the stratum of air that otherwise would cool down to the dew point temperature.

ICE INSIDE, WATER ON ROOF FOR EMERGENCY COOLING

A recent item appearing in several newspapers mentioned that ice had been used for "emergency air conditioning" during commencement exercises at Alfred University, Alfred, N. Y. F. M. Palmer, superintendent of buildings and grounds, has amplified the newspaper story at HPAC's request, and would appreciate any comment or suggestions from readers on a better way to cope with the situation should it arise again.

Mr. Palmer's remarks follow:

"Due to our large enrollment, Alfred University has not an auditorium large enough to seat all the student body and for events such as commencement, where from 1000 to 2000 people gather, it is necessary for us to use our men's gymnasium. This building has an indoor tanbark track around the basketball floor and is one story, with a trussed roof. It is heated with steam radiators in front of circulating fans, has no provision for cooling. Normally, the weather at commencement time is cool enough so that there is no problem in this building. However, this year it was exceptionally hot.

"The baccalaureate service, held on Sunday evening, was attended by about 1000 and the heat and humidity in the gymnasium were almost intolerable. Realizing that it would be much worse in the afternoon, with the sun beating down on the roof, we resorted to the only idea which seemed of value, putting ice around on the track in the building and keeping the roof wet with a fire hose. At 11:00 a.m. we brought in two tons of ice, and this was broken into 25 lb chunks and distributed all around the track. On the two long sides of the floor there are bleachers extending over the track, which are raised with rope and tackle, when the track is used and lowered for seating purposes. This forms a sort of tunnel in which much of the ice was placed. Fans located at one end of each of these bleacher rows circulated the air over the ice and around the room.

"When we discovered that the ice was not melting fast enough to be consumed by the time the service was over, we cut it into smaller pieces.

"The temperature was not recorded on Sunday night, but from the writer's estimate, the Monday afternoon temperature was lowered by 15 deg and the humidity was excellent. We consider the water on the roof to have been as beneficial as the ice but the combination of the two really did the trick."

COIL STANDARDS PROGRESSING

The joint coil committee representing the Refrigeration Equipment Manufacturers Association and the Air Conditioning and Refrigerating Machinery Association, is making definite progress in the development of recommended industry standards for blower coils, according to a recent report. The committee's primary objectives are:

a) To develop industry standards for forced circulation, free delivery air coolers for commercial refrigeration, covering recommendations on methods of testing and rating, minimum standard equipment, safety requirements, and minimum published data; also, application standards pertaining to such air coolers.

b) To develop similar industry standards for natural convection air coolers for refrigeration, including both equipment standards and application standards.

MANY WAYS TO SAVE HEATING STEAM

I have read Charles J. Lehn's article in the July HPAC on steam economies effected in the Field building and agree with everything he says. Mr. Lehn is evidently a man of resourcefulness and ability.

There are, of course, many other ways of saving steam in a large office building such as graduating the supply in accordance with the height of the building, since the upper stories require less steam than the lower stories; stopping the leaks, particularly at the top of the building, etc., and no doubt a man of Mr. Lehn's resourcefulness has considered these angles. His idea and method of offsetting the steam consumption against the build-up of lights and people coming in at the commencement of business hours is, I believe, noteworthy.—EPH. A. TYLER, manager, building dept., First Service Corp., Minneapolis, and member of HPAC's board of consulting and contributing editors.

HIGH PRESSURE HOT WATER HEATING

I found Dr. Paul Reschke's article on high pressure hot water heating in the June HPAC very interesting. He shows that high temperature water for district heating is employed in Europe to the same extent that steam is in America.

Dr. Reschke refers to a high temperature water installation in the city of Dresden, Germany. This installation is one of the oldest and consequently has some features which I believe are considered at present as obsolete. In general, it is considered bad practice to discharge any liquid from the high temperature circulation system. If water is drained off the system it is necessary to install water purification plants to supplement the water discharged and to supervise carefully the feeding system so that no gas enters the circulation lines. The placing of the pump and the expansion tank in the return lines has been superseded, too; this design shows disadvantages. The high temperature water heating systems as designed by us and other companies follow quite different lines of thought.—PAUL L. GEIRINGER, chief engineer, American Hydrotherm Corp., New York City.

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QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Write the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

Blow Water off Bales With Streams of Air

Final operation in a rubber manufacturing process is putting talc powder on the bales to facilitate handling. To avoid an occupational hazard the bales are dipped in a slurry of talc and water. The water must be evaporated, leaving only the talc, and in a question published in the May issue, "F.R.Y." asked for suggestions for doing this

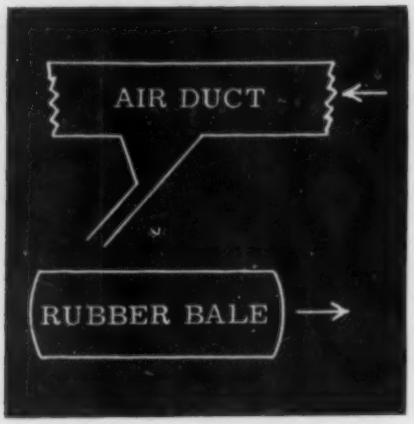
THE PROBLEM of removing excess water from rubber bales as outlined in the May issue is similar to one I encountered a few years ago when it was necessary to remove surface water from tomatoes in a packing plant. In both cases, the time element and the necessity for avoiding high temperatures preclude any vaporization of the water. The only way that the water could be removed was purely mechanical. High pressure air jets literally wiped it off as the tomatoes were caused to tumble down an inclined roller conveyor.

This same principle can be employed to remove the water from the rubber bales. The author of the inquiry doesn't state whether or not the bales move with their long axes at right angles to the rollers but we will assume that this condition exists. Also, the author doesn't tell us how much space there is between bales. Assuming a minimum distance of 1 in., we have $3\times28+2=86$ in. or 7 ft, 2 in. as the distance which the bales travel in 1 minute. This is relatively slow travel—less than 1/10 mph.

If the water adhering to each bale must be removed within 1½ minutes, it means that the work must be accomplished within a distance of approximately 10 ft, 9 in. To do this I would provide four ducts—one each above, below and at each side of the roller conveyor. Projecting from the inside face of each duct I would provide nozzles about ¼ in. wide and as long as the width of that face of the bale adjacent. For example, the ducts above and below the bales would each be about 15 in. wide by 8⅜ in. deep and about 11 ft long. Projecting out of each duct toward the face of the bales would be 12 nozzles each ¼ in. by 14 in. Adjacent to the side faces of the bales would be ducts each about 8 in. wide by 12 in. deep and 11 ft long. Projecting from each duct toward the bales would be 12 nozzles each ¼ in. by 7 in. Air from each nozzle should be discharged toward the oncoming bales at velocities not less than 7500 fpm. The accompanying sketch shows a side elevation of one of the suggested ducts and projecting nozzles.

All four ducts can connect to a plenum chamber into which a centrifugal fan will discharge some 26,000 cfm of air.

There is, however, a possible serious objection to blowing off the water with high velocity jets. Since talc powder is not soluble in water and floats on the surface, the water that adheres to the bales probably will be in the form of globules with a small amount of talc on the surface of each separate globule. As the water is driven away from the



Longitudinal elevation of air duct and nozzle arrangement suggested by "J.R.D." for blowing water from top surface of rubber bales

surface of the bales, the talc may be mechanically carried away with the water. If this should happen, there is a possibility that this difficulty may be overcome by adding a detergent or wetting agent to the water. This will permit the water forming the talc slurry to thoroughly wet all surfaces of each bale. Talc will be deposited uniformly and most of the excess water will drain off when the bales are lifted from the tank of talc slurry. Surface water will not be in globules but in a thin film which can be blown off and evaporated by warm air at approximately 135 F and at much lower velocity. This would eliminate disturbing the talc.

A low pressure steam heating coil can be installed in the duct leading from the fan discharge and thermostatically controlled to provide air at 135 F.—J.R.D.

HOW INSTALL CEILING COILS?

YOU ARE INVITED to answer the following question from a reader of HPAC. Suitable comment on the matter will be welcomed, and—space permitting—will be published. Sketches and photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

"As a subscriber to HPAC for many years, I take the liberty of consulting you on the following problem.

"We are accustomed in this country to install panel heating installations with copper tubes where the copper tubes are in the ceilings and very specially in the lower part of the concrete slabs. The general proceeding in the erection of this type of installation is that after the molding for the slabs has been finished, the reinforcement steel bars are laid and immediately on top of the bars we are installing our copper tube coils for which we are using generally pipes of ½ or ¾ in. interior diameter. We never had any trouble at all in this kind of installation but one of our competitors having the contract for a new office building in this town received instructions not to lay the pipes inside of the concrete, but to have them suspended underneath the slab and covered with plaster.

"Is there any new experience in your country on this problem which might have induced the owner of this building to give these instructions and if there are defects against this type of laying the pipe coils which we have been using all the time, please advise."—W.F.

AIR HEATER CUTS LUMBER DRYING TIME

The Western Crate & Lumber Co., Salt Lake City, has cut drying time for native pine by one-third through the installation of a direct fired warm air heating system in a specially built, "on-the-premises" drying kiln.

With the new system, 27,000 cu ft of pine can be dried in four days in contrast with the six days previously required. The company manufactures egg crates for local poultry producers and supplies native pine on a wholesale basis.

The building used for drying the lumber is 40 ft long by 16 ft wide. It has a concrete floor. The roof is 15 ft high and the ceiling is 9½ ft high. Walls are of wood sheathing on 2 x 4 studding and the interior is lined with corrugated aluminum siding. Insulation between the exterior and interior walls is sawdust.

The heater that supplies the warm air used for drying is fired with No. 3 fuel oil. Located in a shed adjoining the drying building, the heater discharges warm air into the building through two ducts at ceiling height at opposite ends of the building. Other ducts, for return air, are installed at floor level.

In this manner, a continuous flow of air at 140 F is discharged into the kiln at approximately 2000 fpm. Moreover, the heater handles about 4500 cfm of air, about enough to effect a complete air change every 2 min. G. E. Blankenship, manager of the company, explained that operating the heater on recirculated air for three days softens the outer part of the green lumber and permits heat to penetrate into the center. On the fourth day, by adjusting dampers in the air intake duct of the heater, 50 percent fresh air is blended with recirculated air and the humidity is reduced. Moisture-laden air is removed through roof ventilators.

This application was designed for the lumber company by Ashton Heating and Air Conditioning Co., Salt Lake City.

Interior of new drying kiln. Air at 140 F is discharged into the space through the overhead duct at the left, and through another duct at the opposite end. Return air is pulled into floor level ducts at each end. (Photo courtesy Dravo Corp.)

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Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Heat Gains Are Not Cooling Loads†

By C. O. Mackey* and N. R. Gay**, Ithaca, N. Y.

SUMMARY—Information on cooling loads available to engineers consists almost entirely of the total rates of emission of energy by various sources. There are so many variables that influence the true cooling load in addition to these energy release rates that the determination of true cooling load does not lend itself to an exact analytical approach. This paper gives specific examples of the relations between cooling loads and instantaneous rates of energy emission. Examples include: solar roof load in a one-story building; solar roof load in a multi-story building with various roof and floor constructions; cooling load from human occupants. From these examples, tentative general conclusions are drawn concerning the relation between cooling loads and rates of energy emission.

Cooling loads are commonly calculated as if the energy transferred from lights, appliances, occupants and warm surfaces and through glass found its way into the *air* immediately and without reduction. Part of the energy emitted from such sources is in the form of radiation and part is in the form of heat transferred directly to the air by convection. If remote surface cooling of the conditioned air is used (cooling coils or spray chambers), only the convected energy is an immediate and direct cooling load.

Radiation emitted from the sources mentioned is incident upon various surfaces, such as floors, walls, ceilings, and furnishings within the enclosure. The direct absorption of this radiation by carbon dioxide and water vapor and the heat storage capacity of the air are usually negligible in relation to the other effects under consideration.

Radiation incident upon surfaces which do not transmit radiation directly is largely absorbed, but partly reflected, at these surfaces. The energy absorbed may then be (1) stored in the materials with accompanying rise of temperature, (2) conducted through the materials in the direction of decreasing temperature, (3) transferred by radiation to other surfaces at lower surface temperatures, or (4) transferred by convection to the room air when the temperature of the surface exceeds that of the air.

If there is no direct cooling such as is obtained when cold panels in the conditioned space absorb radiation emitted by the primary source, only the heat transferred by convection from the secondary absorbing surfaces to the room air is an immediate cooling load in that space. It is evident that a unique energy balance must exist before the cooling load within the enclosure is equal to the rate of energy emission from primary sources therein.

Storage Effects

Because large quantities of energy are stored in furnishings and building materials, this unique energy balance seldom exists, and the cooling load at a given time is seldom the same as the instantaneous total rate of energy emission from the various sources. Therefore, *heat gains are not cooling loads.*

The common building with its furnishings approaches a constant-temperature energy reservoir. Large quantities of energy are stored with small temperature rise because of the high product of weight and specific heat of the building materials and furnishings.

For example, assume a total rate of energy emission from all sources within an enclosure of 60 Btu per hour for each square foot of floor space. Assume that one-half of this energy is emitted as radiation and one-half immediately transferred to the air by convection; the furnish-

† This study has been made at the suggestion of the Technical Advisory Committee on Cooling Load—W. E. Zieber, *chairman*; C. M. Ashley, R. D. Blum, W. F. Friend, R. H. Heilman, H. W. Heisterkamp, R. C. Jordan, C. F. Kayan, J. N. Livermore, R. H. Lock, C. O. Mackey, J. P. Stewart.

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ings and bounding materials of construction might easily weigh 150 lb per square foot of floor space and have a specific heat of 0.2 Btu per pound per Fahrenheit degree. If all the energy emitted by radiation within the space were stored, the temperature of the storing materials would rise at the average rate of only 1 deg per hour.

Available information on cooling loads consists almost entirely of the total rates of emission of energy by various sources. In short, the engineer has little information on cooling loads. He may be able to find (1) the rates of emission of energy from lights, appliances, people, and warm surfaces and (2) the rate of transmission of energy by glass. Even if he realizes that appreciable portions of this energy are in the form of radiation, he has little data from which to estimate real cooling loads. Not only is he handicapped in the determination of capacities of equipment but when the possibilities of pre-cooling and after-cooling are considered, he has little data concerning the most economic or optimum method of operating the equipment installed.

So many variables, in addition to the energy release rates at that time, influence the true cooling load at any particular time that the determination of cooling load does not lend itself to an exact analytical approach. It is not the purpose of this paper to develop any general, analytical method of solution. Instead, a few examples with simplifying assumptions will be presented and true cooling loads will be estimated and compared with instantaneous rates of emission of energy. From these examples, tentative general conclusions will be drawn, but it must be admitted at once that much more study would be necessary before these conclusions would be completely adequate and entirely sound.

Sources of Energy Emission

For purposes of estimating cooling loads, sources of energy emission within an enclosure may be divided into two groups. One group might include the sources from which the rate of energy emission remains substantially constant with respect to time—*the steady source.* In this group might be placed, for first analysis, people, lighting, and appliances. The second group might include the sources from which the rate of energy emission varies with respect to time—*the unsteady source.* In this group might be placed warm interior surfaces of walls or ceilings and glass areas transmitting solar radiation. If the design day is to be repeated in cyclic fashion, these unsteady sources may generally be classified as periodic with a period of 24 hours.

Steady Sources of Energy

Among the common sources of energy that are usually assumed to be steady in estimating cooling loads are appliances, lights, and people. Some attention has been given to the relation between the rate of input of electrical energy to lights and the resulting cooling load. Measuring cooling loads in a Detroit office building, J. N. Livermore[1] concluded that:

> . . . . in calculating the cooling load due to lighting, there should be a time lag allowance for heating up of building materials with a varying proportion of the energy input going directly to the atmosphere.

Mr. Livermore also found that the greatest apparent differences between true cooling loads and instantaneous rates of energy emission occurred with heavy lighting loads. The calculated peak loads were generally found to be higher than the measured loads.

In interesting studies of a pioneering nature, C. S. Leopold[2], employing simplifying concepts, has used an hydraulic analogue to determine the relation between cooling loads and instantaneous rates of energy input to lights in specific examples.

The authors have used the mathematical equivalent of the analogue, designated as the Schmidt method, in three specific examples of steady sources of energy emission.

[1] Exponent numerals refer to References.

Effect of Lighting Load

Example 1: A lighting load with a steady rate of input of electrical energy of 11.6 Btu per hour (3.4 watts) for each square foot of floor area was analyzed. Following Mr. Leopold, the authors assumed the lighting to be located in each floor of a multi-story building with infinite extent of floors and ceilings (no walls). It was assumed that 20 percent of the energy input to the light was absorbed by the ceiling surface, 47.1 percent by the floor surface, and that 32.9 percent was transferred directly to the air of the enclosure. The floors were assumed to be of cinder concrete 10 in. thick with a thermal conductivity of 0.41 Btu per (hr) (sq ft) (F deg per ft) and a thermal diffusivity of 0.02 sq ft per hour.

In the solution of the partial differential equation of heat conduction in the unsteady state, the floor was divided into six slabs. A constant convection film coefficient of heat transfer of 0.25 Btu per (hr) (sq ft) (F deg) was assumed for the ceiling to air and 0.50 Btu per (hr) (sq ft) (F deg) for the floor to air. The rate of exchange of radiant energy between floor and ceiling was assumed to be 1 Btu per (hr) (sq ft) for each degree of temperature difference. The boundary equations for floor and ceiling surfaces were energy

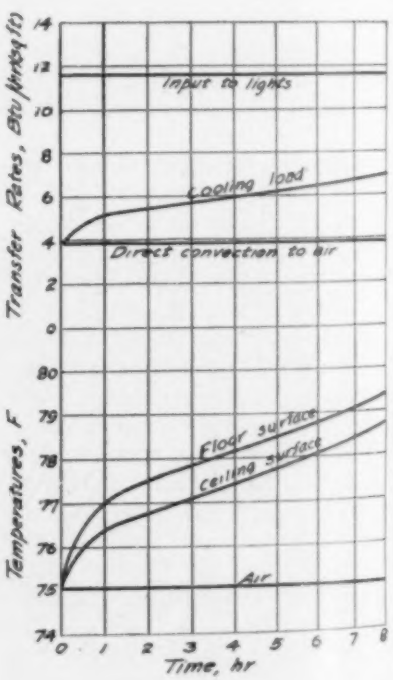

Fig. 1—Temperatures and heat transfer rates for *Example 1*

Multi-story building with 10-in. cinder concrete floors (no walls); Steady lighting load

balances. Details of calculations are not included in this paper.

At the instant of first input of energy to the lights, the entire structure and the air were assumed to be at the same temperature, 75 F. It was assumed that conditioned air was supplied in such state and rate as to maintain a steady air temperature of 75 F.

Results of the calculation are shown in Fig. 1. One significant fact shown in the figure is that eight hours after the lights are turned on, the cooling load is only $\frac{6.9}{11.6}$ or 0.595 times the instantaneous rate of energy supply to the lights. It should be noted, however, that the operative temperature of the environment is increasing with time. Although the temperature of the air is constant, the mean radiant temperature of the enclosure increases as the temperatures of the floor and ceiling surfaces rise.

Occupancy Load

Example 2: The cooling load resulting from human occupancy was studied in this specific case. The rate of sensible heat emission per occupant was assumed to remain steady at 200 Btu per hour, one-half of which was assumed to be transferred directly to the air, while one-half was radiated to the surrounding surfaces of the enclosure. The temperature of the air was assumed to be held constant at 80 F by the supply of conditioned air and at the first instant of occupancy, the temperature of the entire structure was assumed to be 80 F. The area of the enclosing surface was assumed to be 20 sq ft per person, similar to conditions in a theater, and the enclosing material was assumed to have an average thickness of 6 in. with a volumetric specific heat of 30 Btu per (cu ft) (F deg). The temperature of the remote surface of the enclosure was assumed that of an adiabatic surface (no transfer of heat). The average value of the film coefficient of heat transfer by convection from enclosing surface to air was assumed to be 0.4 Btu per (hr) (sq ft) (F deg). The results of the calculation are shown in Fig. 2. At the end of eight hours, the cooling load is only $\frac{130}{200}$ or 0.65 times the rate of emission of energy per occupant.

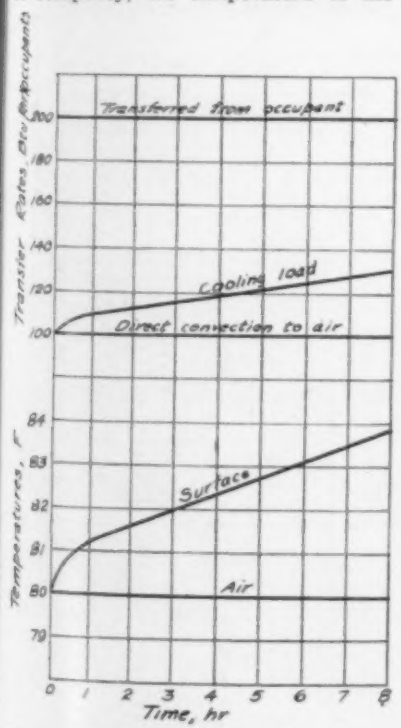

Fig. 2—Temperatures and heat transfer rates for *Example 2*

Steady load from human occupancy of enclosure similar to theater; Steady air temperature

With the temperature of the enclosing surface rising as the temperature of the air remains constant, a steady condition of comfort would not be maintained; the operative temperature of the environment would rise.

Steady Operative Temperature

Example 3: This example is presented as a study of cooling load associated with the maintenance of a steady operative temperature rather than a steady air temperature. It was assumed that a steady operative temperature of the enclosure of *Example 2* might be maintained by keeping the sum of the air temperature and the temperature of the enclosing surface equal to a constant value. In other words, cooling was assumed to be provided in the amount necessary to lower the air temperature one degree for each degree rise in temperature of the enclosing surface. The results of this calculation are shown in Fig. 3. At the end of eight hours, the cooling load in this case is $\frac{150}{200}$ or 0.75 times the rate of emission of energy per occupant.

From these examples and other considerations, the authors conclude that the true cooling load resulting from a steady source of energy either stored or transferred to the air may be represented by the following equation:

$$L = f_c E + R f_r E \quad \ldots\ldots\ldots\ldots (1)$$

where

L = cooling load, Btu per hour
E = steady rate of energy emission from source of load, Btu per hour
f_c = fraction of E that is transferred directly to air (principally by convection from source)
f_r = fraction of E that is radiated to and absorbed by enclosing surfaces

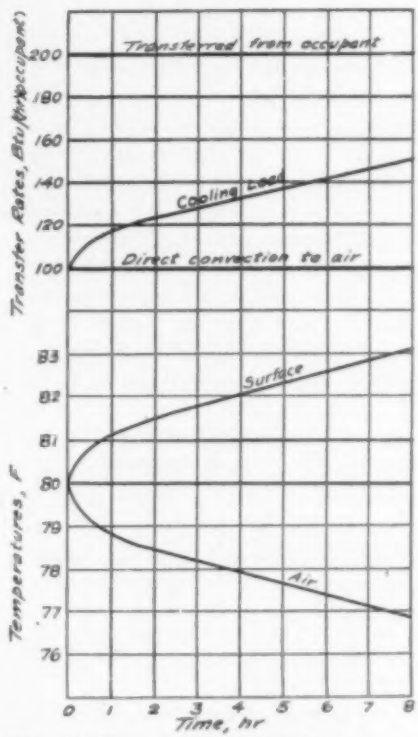

Fig. 3—Temperatures and heat transfer rates for *Example 3*

Steady load from human occupancy of enclosure similar to theater; Steady operative temperature

R = retransfer factor, or the fraction of $f_r E$ which is transferred to the air

To estimate true cooling load resulting from a steady source of energy requires a knowledge of f_c, f_r and R in addition to E. Current conventional methods of estimating cooling load are equivalent to assuming that $R = 1$. If at the instant of the beginning of energy emission from steady source the temperature of the entire storage material equals the air temperature, the true value of R depends (in a complex way) upon the following principal variables:

1. Time θ after beginning of emission of energy.
2. Average thickness x of enclosing and storing material.
3. Average thermal conductivity k of enclosing material.
4. Average volumetric specific heat C of enclosing material.
5. Average film coefficient h of heat transfer by convection from storage surface to air.

The relationship between R and these variables will never be represented by any equation sufficiently general to apply in all possible cases. In Appendix A limiting values of R are derived for a case of uniform

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storage. It is assumed that all energy emitted from the steady source is either stored or transferred to the air. In this case, the storing material is assumed to have an infinitely large thermal conductivity so that the temperatures at various points in the material are assumed to be the same at a particular time. As a result of this assumption the temperature of the enclosing surface at any time is lower than would actually exist and consequently yields a minimum value of R.

One limiting value of R is for the case where a steady operative temperature of the environment is maintained by reducing the air temperature as the surface temperature rises. Then, the minimum retransfer factor is

$$R_1 = 1 - \frac{1}{e^y} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where

e = Naperian base of logarithms

$$y = \frac{2h\theta}{Cx}$$

Another limiting value of R is for the case where a steady air temperature is maintained. Then, the minimum retransfer factor is

$$R_2 = 1 - \frac{1}{e^{y/2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

In the equation for y, the variables h, θ, C, and x are expressed in units that will make y dimensionless; commonly, h is in Btu per (hour) (square foot) (Fahrenheit degree); θ is in hours; C is in Btu per (cubic foot) (Fahrenheit degree); and x is in feet.

Values for the retransfer factors R_1 and R_2 are shown in Fig. 4. In this figure are also shown the actual retransfer factors found in *Examples 1, 2,* and *3*. A constant operative temperature was maintained in *Example 3* and a constant air temperature in *Examples 1* and *2*. The actual retransfer factors obtained in *Examples 1* and *2* lie above R_2 for any value of y, and the actual retransfer factors in *Example 3* lie above R_1. The reason for this is that uniform storage was not assumed in working the examples. Unsteady state conduction of heat through a material with finite conductivity and with a temperature gradient was going on. With these conditions, the surface temperature at a particular time reaches higher values than with uniform storage.

Fig. 4 is presented as a guide in estimating a reasonable value for the retransfer factor in any actual case. It is clear that this factor is significantly smaller than 1.0. The analysis does not show the effect of pre-cooling or of conduction of heat out of the enclosure. Obviously, smaller values of R may be used if the material of the structure is cooled before the beginning of energy emission, or if heat is conducted out of the enclosure.

Summarizing: in Equation 1 the value to be assumed for the retransfer factor R will be *low* for: pre-cooling; conduction of heat away from enclosure; high values of k, C, and x; and low values of h and θ.

Periodic Sources

Among the important periodic sources of cooling load are: (1) energy transferred through roofs and walls; (2) energy transferred through sunlit glass. Specific examples are presented to illustrate the difference between instantaneous rates of heat transfer from the room side of horizontal roofs and the true contributions to the cooling loads from such heat transfers.

In THE GUIDE, the instantaneous rate of heat transfer from horizontal roofs is estimated by means of the following equation:

$$\frac{q}{A} = U\,(t_m - t_i) + \lambda U\,(t_e^* - t_m) \quad \ldots\ldots (4)$$

where

$\frac{q}{A}$ = instantaneous rate of heat transfer, Btu per (hour) (square foot)

t_m = average daily sol-air temperature for the locality, solar absorptivity of roof surface, and outdoor air film coefficient of heat transfer, Fahrenheit degrees

t_i = constant indoor air temperature, Fahrenheit degrees

t_e^* = sol-air temperature at a time earlier than the time for which the rate of heat transfer is being found by an amount equal to the time lag of the roof, Fahrenheit degrees

λ = amplitude decrement factor with a value that depends upon the thickness and material of the roof*

The values of λ are based on charts which use an outdoor air film coefficient of heat transfer of 4.0 Btu per (hr) (sq ft) (F deg) and an indoor surface coefficient of heat transfer by radiation and convection of 1.65 Btu per (hr) (sq ft) (F deg). If these same values are used in calculating the overall coefficient of heat transfer,

$$U = \frac{1}{0.856 + \sum \frac{L}{k}}$$

Btu per (hr) (sq ft) (F deg)

where

$\sum \frac{L}{k}$ = thermal resistance to conduction of heat of roof materials.

* HEATING, VENTILATING, AIR CONDITIONING GUIDE, 1949, CHAPTER 15, TABLE 12, p. 289.

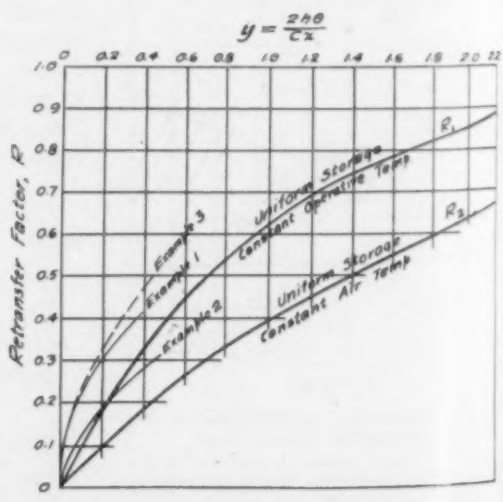

Fig. 4—Chart for estimating value of retransfer factor R

The corresponding value of the temperature of the room side of the roof is

$$t_c = t_1 + 0.606 \frac{q}{A}$$

When the temperature of the air in the enclosure is held constant, this calculated value of heat transfer may fail to represent the true cooling load from the roof at any particular time if any of the energy radiated from the room side of the roof is being stored in absorbing materials or conducted from the enclosure to any heat sink outside the building. Also subject to question is the value of 1.65 for the so-called "combined" surface coefficient of heat transfer. For the levels of temperature and the materials involved, the rate of energy transfer by radiation to the surfaces surrounding the ceiling is substantially $(t_c - t_s)$ Btu per hour per square foot per Fahrenheit degree, where t_s represents the average temperature of the absorbing surfaces. McAdams[3] recommends the following equation for surface coefficient of heat transfer by convection from warm ceiling to cooler air:

$$h = 0.2\ (t_c - t_1)^{0.33}\ \text{Btu per (hr) (sq ft) (F deg)}$$

There is no doubt that the convection transfer from the ceiling is a direct cooling load, but depending upon the value of the retransfer factor, only part of the energy radiated from ceiling to surroundings may be cooling load.

Effect of Heat Storage and Conduction

Example 4: This example shows how the cooling load may be far less than the instantaneous rate of heat transfer from the room side of the roof. This is caused by the combined effects of (1) storage of energy in absorbing materials, and (2) conduction of heat to a heat sink outside the enclosure.

In this example, the building consists of a single story with indefinite extent of roof and floor and no walls. All energy radiated from the ceiling is assumed to be absorbed by the floor. The assumed roof construction is 2 in. concrete and 1 in. rigid insulating board. The floor is assumed to be a 10-in. slab of cinder concrete [k = 0.41 Btu per (hr) (sq ft) (F deg per ft); thermal diffusivity = 0.02 sq ft per hour] directly on the ground; the earth side of this floor slab is assumed to remain at 55 F, and the temperature of the air is assumed to be constant at 80 F.

The temperature of the ceiling was calculated from sol-air temperature data in the conventional manner (solar absorptivity = 1.0; λ = 0.85; U = 0.2; time lag = 1.5 hours; locality, New York). The floor was divided into 5 slabs. The Schmidt method was used to determine the effects of heat conduction in the unsteady state. Results are shown in Fig. 5.

At the time of maximum true cooling load (2:30 p.m.), it is interesting to note the following:

$$1.65\ (t_c - 80) = 1.65\ (88.2 - 80) = 13.5\ \text{Btu per (hour) (square foot)}$$

Conventional estimated load

$$= (88.2 - 80) + 0.2\ (88.2 - 80)^{1.33}$$

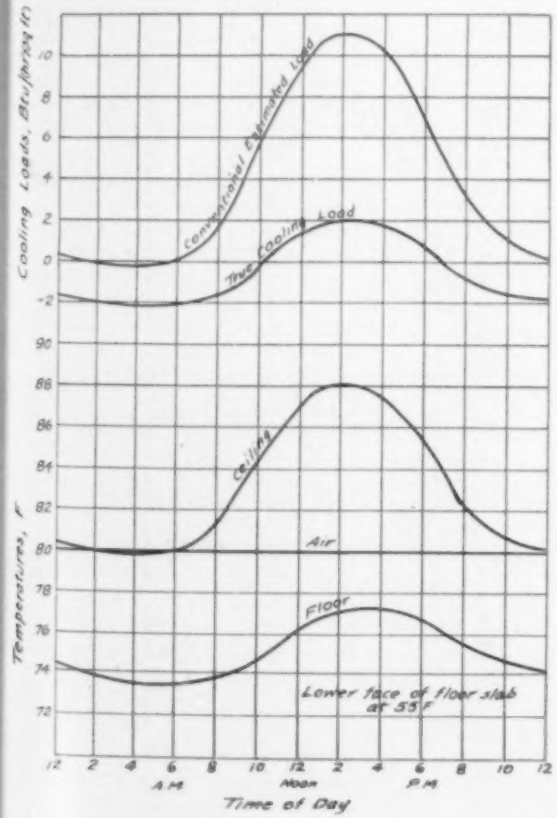

Fig. 5—Temperatures and cooling load for *Example 4*

Single-story building; 10-in. cinder concrete floor slab on ground

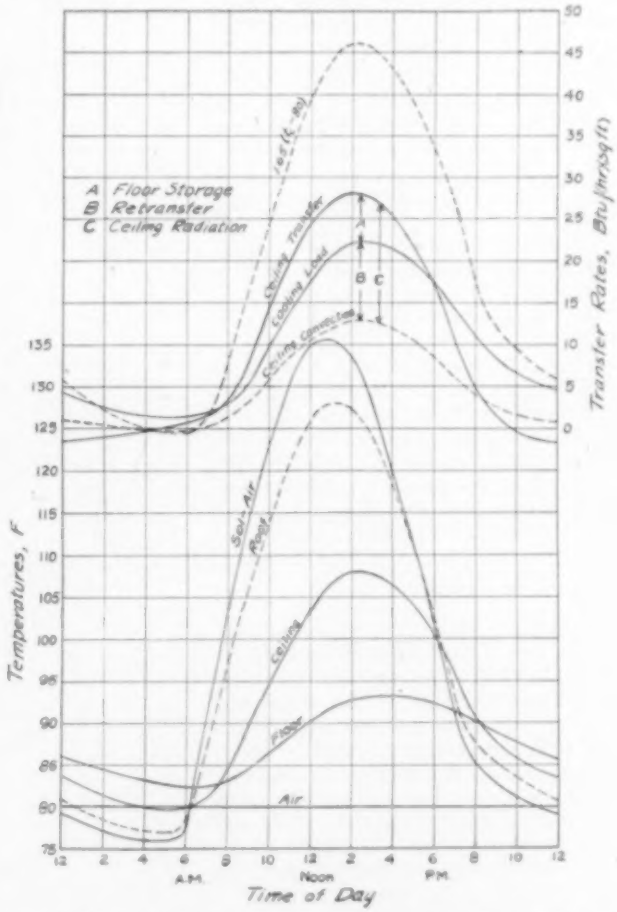

Fig. 6—*(Right)* Temperatures and transfer rates for *Example 5*

4-in. cinder concrete roof slab; 6 in. cinder concrete floor slab with adiabatic remote surface constant air temperature

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= 11 Btu per (hour) (square foot)

True rate of transfer of heat from ceiling to air and floor =

$(88.2 - 77.2) + 0.2\,(88.2 - 80)^{1.25}$

= 13.8 Btu per (hour) (square foot)

True cooling load, ceiling and floor convection =

$0.2\,(8.2)^{1.25} - 0.2\,(2.8)^{1.25}$

= 2.0 Btu per (hour) (square foot)

Rate of conduction of heat into ground = 10.1 Btu per (hour) (square foot)

Rate of storage of heat in floor slab = 1.7 Btu per (hour) (square foot)

Example 5: For the purpose of presenting the effect of storage alone without any transfer of heat away from the enclosure, *Example 5* is chosen to represent another building, without walls, and with a roof slab of 4 in. cinder concrete and a floor slab of 6 in. cinder concrete. The temperature of the air is assumed constant at 80 F. The under side of the floor slab is assumed to be an adiabatic surface across which no heat is transferred. Sol-air temperatures and a solar absorptivity of 0.7 were taken for New York. In this example, the transfer of heat is studied entirely by means of the Schmidt method, and no previous calculations other than sol-air temperature are required. The results are shown in Fig. 6.

At the time of maximum cooling load (2:30 p.m.) the following instantaneous rates are of interest, such as the rate of:

Entry of heat into weather surface of roof = 23.6 Btu per (hour) (square foot).

Transfer of heat from ceiling to air = 12.8 Btu per (hour) (square foot).

Radiation of energy from ceiling to floor = 15.4 Btu per (hour) (square foot).

Storage of energy in roof material = –4.6 Btu per (hour) (square foot).

Retransfer of heat from floor to air = 9.3 Btu per (hour) (square foot).

True cooling load = 12.8 + 9.3 = 22.1 Btu per (hour) (square foot).

Rate of storage of energy in floor = 6.1 Btu per (hour) (square foot).

Ratio of retransfer from floor to radiation from ceiling $= \frac{9.3}{15.4} = 0.6$

At the time of maximum cooling load, 60 percent of the radiation emitted by the ceiling is being retransferred to the air by the floor surface and 40 percent is going into storage in the floor. When the enclosure is in heat exchange relationship only with outdoor air and sun (as in this example), the heat transferred in 24 hours from the ceiling and floor to the air must be the same as the heat transferred from the ceiling to the air and floor in that time.

If, at some times, the cooling load is less than the instantaneous rate of transfer of heat from the ceiling, at other times this situation must be reversed. As Fig. 6 shows, the retransfer factor is exactly 1.0 at two times of day, about 8 a.m. and 6 p.m. During the day, between 8 a.m. and 6 p.m., the retransfer factor is less than 1.0. During the evening, between 6 p.m. and 8 a.m., the retransfer factor is greater than 1.0.

Example 6: Although the temperature of the air is held constant at 80 F in *Example 5*, a steady operative temperature is not being maintained in the enclosure because of the varying temperatures of the ceiling and floor. *Example 6* is the same building as *Example 5* with a constant *operative temperature* of 80 F instead of a constant *air temperature* of 80 F. The operative temperature is assumed to be equal to the sum of one-fourth of the temperature of the ceiling, one-fourth of the temperature of the floor, and one-half of the temperature of the air. In other words, attention is given to the effect of mean radiant temperature upon comfort. The results are shown in Fig. 7. At the time of maximum cooling load (2:30 p.m.), the following instantaneous rates are of interest, such as rate of:

Entry of heat into weather surface of roof = 28.4 Btu per (hour) (square foot).

Transfer of heat from ceiling to air = 17.5 Btu per (hour) (square foot).

Radiation of energy from ceiling to floor = 16 Btu per (hour) (square foot).

Storage of energy in roof material = –5.1 Btu per (hour) (square foot).

Retransfer of heat from floor to air = 15.7 Btu per (hour) (square foot).

True cooling load = 17.5 + 15.7 = 33.2 Btu per (hour) (square foot).

Rate of storage of energy in floor = 0.2 Btu per (hour) (square foot).

Ratio of retransfer from floor to radiation from ceiling $= \frac{15.7}{16} = 0.98$.

In this example, the instantaneous cooling load is never significantly different from the instantaneous rate of heat transfer from ceiling to air and floor. In other words, the retransfer factor is never significantly different from 1.0.

Conclusions

Steady Sources of Energy Emission

1. The instantaneous contributions to the cooling load from steady sources of

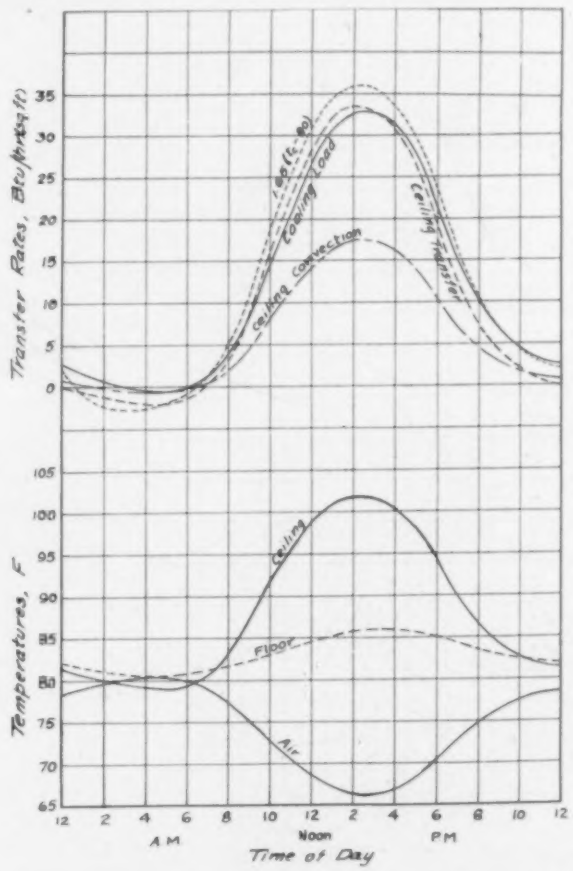

Fig. 7—Temperatures and heat transfer rates for *Example 6*

4-in. cinder concrete roof slab; 6-in. cinder concrete floor slab with adiabatic remote surface; constant operative temperature

energy emission having appreciable components of radiation (such as lights, people, and appliances) may be significantly less than the instantaneous rates of energy emission.

2. Sufficient examples with simplifying assumptions have been presented to permit a reasonable estimate of the retransfer factor. It is suggested that Equation 1 and Fig. 4 be used to estimate cooling loads from steady sources.

3. Additional information that might be compiled to assist in the estimate of cooling loads from steady sources consists of the fraction of the energy emission in the form of convection and the fraction in the form of radiation.

Periodic Sources of Energy Emission

1. The instantaneous contributions to the cooling load from sources of periodic energy emission like roofs, walls, and sunlit glass may be less than the instantaneous rates of energy emission at the time of maximum cooling load.

2. The instantaneous cooling loads may be appreciably less than the instantaneous rates of energy emission under the following conditions: (*a*) when pre-cooling or after-cooling is used, (*b*) when a constant air temperature is maintained, and (*c*) when any appreciable portion of the structure is in heat exchange relationship with a relatively cool heat sink, like the ground, in addition to being in heat exchange relationship with the sun and outdoor air.

3. If a steady operative temperature is maintained by lowering the temperature of the air as the mean radiant temperature of the enclosure rises, the instantaneous maximum cooling load may not be significantly less than the instantaneous rate of energy emission at the time of maximum load.

4. More study should be given the problem of estimating cooling loads from sources of periodic energy emission.

APPENDIX A

The following symbols are used:

E = steady rate of energy emission, Btu per (hour) (square foot of floor space).

L = actual cooling load at any time, Btu per (hour) (square foot of floor space).

A = area of storage surface per square foot of floor, square feet.

f_c = fraction of E that is transferred directly to air.

f_r = fraction of E that is radiated to and absorbed by enclosing surface.

t = temperature of storing surface at any time, Fahrenheit degrees.

t_a = temperature of air at any time, Fahrenheit degrees.

x = average thickness of storage material, feet.

Ax = volume of storage material per square foot of floor, cubic feet.

C = volumetric specific heat of storage material, Btu per (cubic foot) (Fahrenheit degree).

h = average film coefficient of heat transfer by convection from storage surface to air, Btu per (hour) (square foot) (Fahrenheit degree).

θ = time after beginning of steady energy emission, hours.

Special assumptions: all energy radiated from steady source is either stored or convected to room air; no temperature gradient in materials storing energy. The latter assumption, the equivalent of assuming the storage material to have an extremely large thermal conductivity, may be regarded as a limiting case only.

Energy balance

$$f_r E = hA\ (t - t_a) + C\ Ax \frac{dt}{d\theta} \quad \ldots\ldots (A1)$$

$$\int_0^\theta d\theta = CAx \int_{t_o}^{t} \frac{dt}{f_r E - hA\ (t - t_a)} \quad \ldots\ldots (A2)$$

Special cases of integration: Case 1. Assume that comfort is maintained by having the temperature of the air decrease one degree for each degree of increase in the temperature of the surface of the enclosure.

Comfort equation

$$t + t_a = K \quad \ldots\ldots (A3)$$

where K is a constant.

Integration of Equation *A*2 under the conditions imposed by Equation *A*3 gives

$$\int_0^\theta d\theta = -CAx \int_{t_{ao}}^{t_a} \frac{dt_a}{f_r E - hA\ (K - 2\ t_a)}$$

and

$$t_a = \frac{2hA\ t_{ao} - f_r E\ (e^y - 1) + hAK\ (e^y - 1)}{2\ hA\ e^y} \quad \ldots\ldots (A4)$$

where

$$y = \frac{2h\theta}{C\ x} \quad \ldots\ldots (A5)$$

The contribution to the cooling load from the energy radiated from the steady source is

$$L_r = hA\ (t - t_a) = \frac{hA\ (K - 2t_{ao}) + f_r E\ (e^y - 1)}{e^y} \quad \ldots\ldots (A6)$$

If it be assumed that, at $\theta = 0$, the uniform temperature of the storage material is the same as that of the air at that time (or $t_o = t_{ao}$), and if the comfort equation is satisfied at that time,

$$L_r = \frac{f_r E\ (e^y - 1)}{e^y} \quad \ldots\ldots (A7)$$

The ratio of this instantaneous contribution to the cooling load to the instantaneous rate of energy emission by *radiation* from the steady source is

$$R_1 = \frac{L_r}{f_r E} = 1 - \frac{1}{e^y} \quad \ldots\ldots (A8)$$

Case 2. Assume that the temperature of the air in the enclosure is held constant. Integration of Equation *A*2 under the new conditions gives

$$t = \frac{hAt_o + f_r E\ (e^{y/2} - 1) + hA\ t_a\ (e^{y/2} - 1)}{h\ A\ e^{y/2}} \quad \ldots\ldots (A9)$$

The contribution to the cooling load from the energy radiated from the steady source is

$$L_r = hA\ (t - t_a) = \frac{hA\ (t_o - t_a) + f_r E\ (e^{y/2} - 1)}{e^{y/2}} \quad \ldots\ldots (A10)$$

If it be assumed that, at $\theta = 0$, the temperature of the storage material is the same as that of the air at that time (or $t_o = t_a$),

$$L_r = \frac{f_r E\ (e^{y/2} - 1)}{e^{y/2}} \quad \ldots\ldots (A11)$$

The ratio of this instantaneous contribution to the cooling load to the instantaneous rate of energy emission by *radiation* from the steady source is

$$R_2 = \frac{L_r}{f_r E} = 1 - \frac{1}{e^{y/2}} \quad \ldots\ldots (A12)$$

References

1. Study of Actual *vs.* Predicted Cooling Load on an Air Conditioning System, by James N. Livermore. (ASHVE TRANSACTIONS, Vol. 49, 1943, p. 287.)

2. Mechanism of Heat Transfer, Panel Cooling, Heat Storage, *Refrigerating Engineering*, July 1947; Part II—Solar Radiation, June 1948, by Charles S. Leopold.

Hydraulic Analogue for the Solution of Problems of Thermal Storage, Radiation, Convection and Conduction by Charles S. Leopold. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, July 1948, p. 105.)

3. Heat Transmission, by William H. McAdams. (Second Edition, McGraw-Hill Book Co., p. 240.)

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DISCUSSION

C. S. LEOPOLD, Philadelphia, stated that although the examples in this paper contain many approximations, the overall result was of importance as a contribution to the knowledge of the general nature of the problem of heat storage and storage limits. In this paper, and in a paper[3] previously published by Mr. Leopold the analysis had been confined to one day in which air temperature and structure temperature have been considered uniform and equal at zero time. In a real system operated to hold air temperature constant for a day, it is apparent that the structure will be at a temperature above the design room air temperature on the succeeding day.

Mr. LEOPOLD showed results of a problem solved by means of the hydraulic analogue, assuming one hour of pre-cooling and one hour of after cooling with the room air temperature maintained constant at the design temperature. He illustrated graphically that for each succeeding day the structure temperature increased, and consequently, there was an increased requirement for cooling for each succeeding day. He pointed out that pre-cooling normally does not mean that the average temperature of the structure need be reduced below room air temperature, but means rather that frequently its excess above room temperature is reduced. The practical significance of this is that the building can be satisfactorily pre-cooled by lowering the room air temperature and restoring thermostatic control shortly before its contemplated use without encountering the deleterious effect of starting with a cold room. Referring to the comparisons made in the paper between maintenance of constant operative temperature and maintenance of constant room air temperature, Mr. LEOPOLD mentioned several factors to be considered in analyzing the problem. First, in a normal room there would be 6 sq ft of surface per square foot of floor space, and therefore surface temperature rise would be only one-third of that predicted for the empty interior zone considered in the paper. Second, variation in the comfort effect caused by mean radiant temperature variation is less for a change of one degree near the optimum effective temperature than when the room is operated near a 73 or 74 deg effective temperature.

J. N. LIVERMORE, Detroit, Mich., complimented the authors on preparing a very clear statement of a complex problem. He felt that their estimates of the range of magnitude of error possible in estimating apparatus load from a radiant heat source should attract wide attention in the application engineering field. He stated that while the rate at which heat enters an air conditioned enclosure can be estimated with fair precision, the rate at which this heat reaches the cooling apparatus is largely a matter of guesswork.

Mr. LIVERMORE referred to the authors' use of a constant operative temperature, a condition in which the room dry-bulb temperature is adjusted to compensate for mean radiant temperature, and stated that control accomplishing such regulation is rarely used since most systems are operated either automatically or manually to maintain a constant air temperature.

Additional written discussions were received from R. S. Dill, Washington, D. C.; L. T. Avery, Cleveland, Ohio; J. D. Kroeker, Portland, Ore.; John Everetts, Jr., Philadelphia, Pa.; J. P. Stewart, Syracuse, N. Y.

Mr. DILL felt that more study should be given the problem of estimating cooling loads from sources of periodic energy emission, and expressed the hope that further efforts in the direction of the present paper would produce practical computation methods or approximations which would facilitate economical design. He also referred to the possibility of putting masonry and structural masses of buildings on the inside rather than on the outside of the insulating layer in order to increase the effective heat capacity of the structure.

Mr. AVERY commented on the difference between heat gains and cooling loads, and mentioned that since all of the calculated sources of heat input do not reach a maximum at the same time, cooling loads are generally less than estimated and, consequently, cooling equipment frequently is found to be oversized. He mentioned the theory advanced by H. W. Heisterkamp, Cleveland, Ohio, who feels that the absorption of water vapor during the night cooling period takes place in the various insulating materials. This reservoir of water vapor contributes a cooling effect by re-evaporation when the heat rises in the structure during the day. Walls, therefore remain cool longer than would be expected due to this presence of absorbed water vapor.

Mr. KROEKER remarked that the presentation in this paper of methods of analyzing the magnitudes of known discrepancies between sources of instantaneous heat gain and cooling load was a very valuable contribution to air conditioning engineering.

Mr. EVERETTS pointed out that where there is a high concentration of people within a space, the radiation from people will be partly to each other and partly to the chairs or seats, and therefore all of the radiation cannot be assumed to be absorbed by the surfaces of the enclosure. Under such conditions a greater portion of the radiant heat would be converted into convection, thus increasing the cooling load. The absorption of moisture by hygroscopic material within a reasonably tight enclosure was mentioned as a factor which would have a definite effect on the cooling load. An example cited was a department store containing many tons of hygroscopic material which might store a very large amount of moisture. Preliminary calculations of one medium sized department store had indicated that a 10-deg rise in temperature over a weekend would release approximately 1,500,000 Btu of latent heat which must be removed from the space, in addition to latent heat entering by infiltration when the system is to be in operation after the weekend. This increased pulldown load will result in a higher ambient dry-bulb temperature in the space, and will reduce the sensible cooling load and increase the heat storage in the surfaces of the enclosure. A greater period of time will therefore be required to reach equilibrium conditions, and calculations for an eight-hour day will therefore not show the true cooling load.

Mr. STEWART suggested that the analysis of cooling loads as given in the paper should be followed by carefully controlled experimental work in the laboratory to determine the possibility of using equipment smaller than customarily selected for cooling purposes.

W. E. ZIEBER, York, Pa., stated that the Technical Advisory Committee on Cooling Load, following a discussion of the factors affecting cooling load, invited Professor Mackey to present a discussion on the general subject with the thought that such a discussion would be of great value to the Society. He felt that Professor Mackey had covered very well the thinking of the Committee regarding the various phases involved. The Technical Advisory Committee would be pleased if this work would incite discussion for the purpose of broadening the Committee's thinking and thereby allow its members to arrive at a successful conclusion, whether through experimental work or otherwise. The purpose is to establish a method of determining satisfactorily the cooling loads arising from various types of radiant heat sources and thereby help the engineers who calculate loads and design air conditioning equipment.

[3] A Hydraulic Analogue for the Solution of Problems of Thermal Storage, Radiation, Convection and Conduction, by C. S. Leopold. (ASHVE JOURNAL SECTION, July 1948, p. 105.)

AUTHORS' CLOSURE: The authors are grateful to Mr. Leopold for his discussion and particularly for the data obtained from the hydraulic analogue showing the effects of operation on successive days. Mr. Leopold properly questions the assumption of *Example 2*, where the rates of heat transfer from each occupant by radiation and convection were assumed to remain constant with time even though the temperature of the enclosing surface increased about 3.9 deg in 8 hours. To answer this criticism, *Example 2* has been recalculated with an assumed area of enclosing surface of 300 sq ft per occupant in place of 20 sq ft; other conditions were assumed to remain the same. The results of this new calculation, *Example 2A*, are given in the accompanying table.

Time, hr	Temperature of Enclosing Surface, F	Cooling Load, Btu per hr
0	80.00	100
1	80.06	109
2	80.12	113
3	80.14	116
4	80.16	119
5	80.18	122
6	80.21	125
7	80.23	128
8	80.25	130

The temperature of the surface rises but little in 8 hours, and the assumption of no change in the rates of heat transfer by radiation and convection may now be justified. The importance of the new example is that the cooling loads and retransfer factors at a particular time are not changed from the results obtained in the original case.

As Mr. Leopold points out, the temperature 55 F assumed for the isothermal surface of the floor slab in contact with the ground in *Example 4* is too low to be of great practical significance. To answer this criticism, the authors have recalculated *Example 4* for a temperature of this surface of 70 F (*Example 4A*). A comparison of the results obtained in *Examples 4* and *4A* at 2:30 p.m. are given in the table at the bottom of this page.

The retransfer factor is increased but not by a large amount.

Mr. Livermore points out that the most common method of control of air conditioning installations is to maintain a constant air temperature, not a constant operative temperature. The purpose of the authors in introducing operative temperature in some of the examples is to show that cooling loads and retransfer factors are higher if any attempt is made to reduce air temperature in order to compensate for rise in mean radiant temperature. In his discussion, Mr. Leopold has indicated the comfort tolerances that are involved.

The complexity of problems in unsteady state heat transfer are accented in Mr. Dill's discussion. From considerations of heat transfer and storage effects, alone, cooling loads may be reduced by the use of low-density materials near the weather side of structure and high-density materials near the room side.

The authors agree with Mr. Kroeker and Mr. Stewart that more data are necessary on the relation between cooling load and instantaneous rates of heat transfer, particularly for unsteady sources such as glass. Both additional analysis and experimental work would be helpful.

Mr. Avery and Mr. Everetts mention the behavior of hygroscopic materials and the cyclic nature of the effect of changes in moisture content of such materials of construction. No analysis of latent loads is contained in this paper, but the effects of storage on such loads may be significant.

Mr. Everetts questions the assumptions made in *Example 3*. The comment is similar to that of Mr. Leopold's criticism of *Example 2*. With an increase in the area of enclosing surface per occupant, the rise in temperature of the enclosing surface would be reduced and the assumption of steady rates of heat transfer by radiation and convection from the occupant could more readily be justified. It is doubtful, however, that the value of the retransfer factor would be changed significantly, and this is the important result. Any increase in convection from a source, and a corresponding decrease in radiation, tends to make storage effects less important and causes the cooling load to be a greater fraction of the rate of energy emission from source even for the same value of the retransfer factor.

The authors appreciate the considerable additional information which all of those who discussed this paper have contributed to the analysis of a complex problem.

	Example 4	Example 4A
Temperature of ceiling, F	88.2	88.2
Temperature of room surface of floor slab F	77.2	81.2
Conventional estimated load, Btu per (hr) (sq ft)	11.0	11.0
True rate of heat transfer from ceiling to air and floor, Btu per (hr) (sq ft)	13.8	9.8
True cooling load (ceiling and floor convection), Btu per (hr) (sq ft)	2.06	3.26
Rate of conduction of heat into ground, Btu per (hr) (sq ft)	10.10	4.50
Rate of storage of heat in floor slab, Btu per (hr) (sq ft)	1.64	2.04
Retransfer factor	—0.065	+0.069

PERSONALS

Hollis L. Farrow has become treasurer of the George E. Warren Heating Corp., Lynn, Mass. The recently organized corporation will be concerned with the installation and servicing of heating equipment. Head of the new firm is S. A. McLellan, Saugus, Mass.

D. W. Blair has been appointed General Manager of the H. E. Whitten Co., Boston, Mass., as announced by H. E. Whitten, president of the company. Mr. Blair, formerly with the Boston Edison Co., is vice president of the Massachusetts Chapter of the ASHVE.

John J. Kramer has been named vice president of American Thermal Industries, Inc., Detroit, according to recent announcement. Mr. Kramer was formerly with the American Blower Corp., Detroit.

John S. Webb and Robert E. Wilkinson have formed an association for the practice of engineering under the firm name of Webb and Wilkinson, with offices at 177 State St., Boston, Mass.

JOURNAL SECTION

Pressure Loss and Air Flow Characteristics of a Box Plenum□

By S. F. Gilman,* R. J. Martin,** W. R. Hedrick,† and S. Konzo,†† Urbana, Ill.

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SUMMARY—An investigation of a box plenum with six branch outlets has been conducted. The performance characteristics obtained include the distribution of air to the outlets, the flow pattern inside the plenum, and the pressure losses.

Five separate entrance sections for introducing air into the plenum have been investigated. The performance of one section, the *Type 5*, was found to be excellent, the pressure loss being about one-half that of the conventional abrupt expansion entrance section. Construction details and tentative design data for the use of the *Type 5* section are given.

The results show that the entrance section must be designed for minimum pressure loss if unstable operation of the system is to be avoided.

Box plenums are often used as central air distributing compartments for individual ducts when located in (1) attics, in conjunction with either *overhead supply* or ceiling panel systems; (2) ceilings of halls or closets in basementless homes; and (3) in basements, when the conditioner is not centrally located or the basement height is not sufficient to accommodate a bonnet. The term *box plenum* as used in this paper refers to a type of plenum having a large cross-sectional area relative to the inlet area. The cost of the box plenum system is often substantially less than that of the conventional system, since the box is of rectangular construction without transition sections, and the branch take-off fittings consist of simple butted connections.

The design of such plenums is hampered by the lack of information available to the engineer. Although abrupt expansion and contraction loss data are available and could conceivably apply to the respective entering and leaving losses of a plenum, no data are available for evaluating (1) the turbulent mixing of the air in a plenum, (2) the effect of the number, size, and location of the outlets on the performance of a plenum, and (3) the effect of the physical dimensions of a plenum, such as length, on the pressure loss and air flow characteristics.

In order to extend present knowledge of the performance characteristics of plenums, an investigation of a box plenum with six branch outlets has been conducted. The performance characteristics obtained include the distribution of air to the outlets, the flow pattern inside the plenum, and the evaluation of the pressure losses. The factors investigated and discussed in this paper are:

1. Performance characteristics of a box plenum having the conventional abrupt expansion entrance.
2. Comparative performance of five entrance sections.
3. Performance characteristics of an internal expansion section and tentative design data for its use.

Description of Test Apparatus

The general test arrangement is shown in Figs. 1 and 2. The four orifices in the orifice box were used to measure the total air quantity entering the system, and were used singly or in parallel, depending upon the range of volumes used. The centrifugal blower in the fan section discharged air from the orifice box into the trunk duct leading to the box plenum. Two adjustable rheostats, in conjunction with a d-c motor, provided fan speed variation over a wide range. The resistance plate and egg-crate straightener provided uniform flow conditions at Station 2. The top and bottom of the box plenum were made of plexiglass to permit visual observation of directional indicators consisting of 480 silk strings uniformly spaced inside. The six branch outlets were made as exactly alike as possible and were located in a symmetrical pattern about the plenum. The air quantity leaving the system through any outlet was measured by means of an orifice in the outlet. The dampers were adjustable and were used to control the volume flowing in the outlets.

The static pressures in the system were measured by piezometer rings at Station 1, 2, 61, and 62, and by static pressure taps at all other stations. Rubber tubing connected all stations to inclined draft gages mounted on the instrument panel.

In addition to the test arrangement shown in Figs. 1 and 2, which

□ Appendices A and B will be published in the ASHVE TRANSACTIONS, Vol. 55, 1949.

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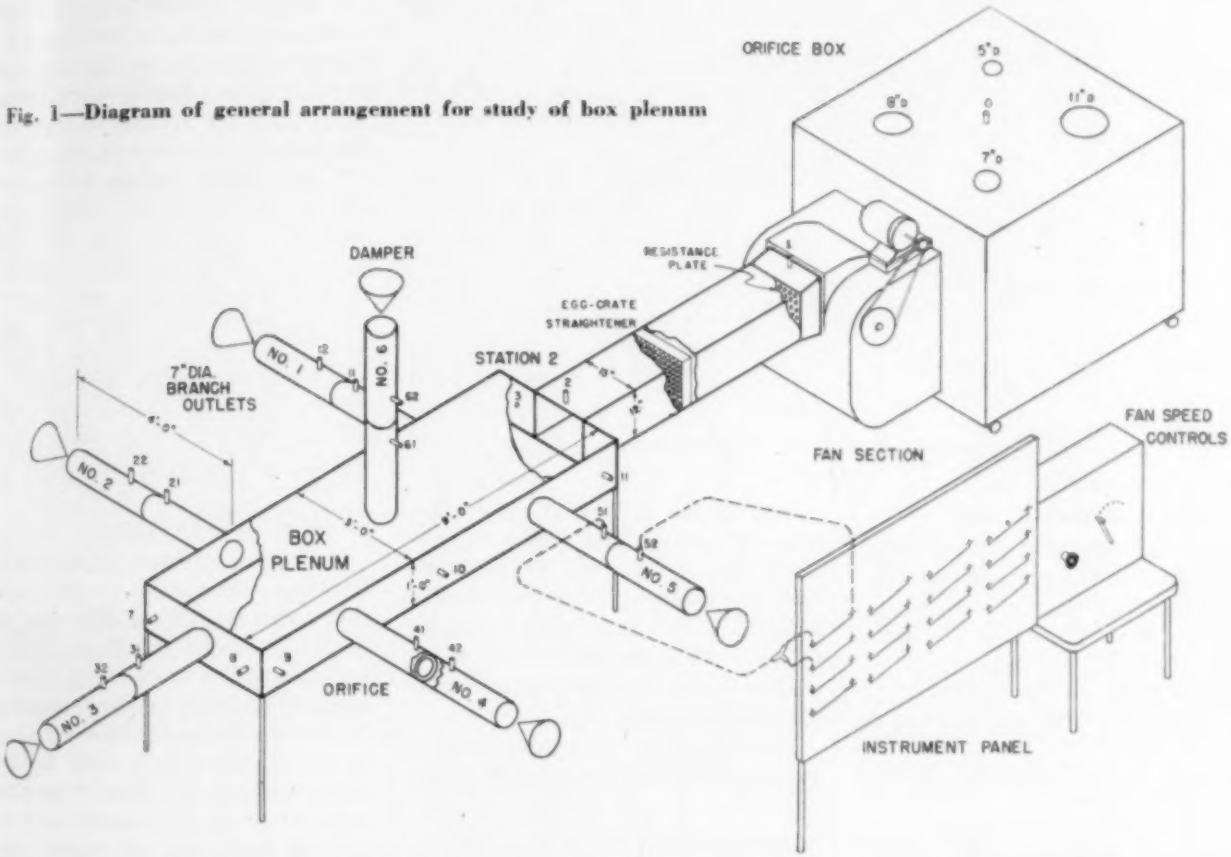
** Assistant Professor of Mechanical Engineering, University of Illinois.
† Special Research Assistant, University of Illinois.
†† Professor of Mechanical Engineering, University of Illinois. Member of ASHVE.

Presented at the Semi-Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Minneapolis, Minn., June 1949.

Fig. 1—Diagram of general arrangement for study of box plenum



has been designated *remote* to signify that the fan is not discharging directly into the plenum, several other test arrangements were utilized. A *close coupled* fan position was produced by removing the five and one-half feet of trunk duct, including the egg-crate straightener and the resistance plate; then reconnecting the equipment. Several other test arrangements were provided by changing the locations of outlets No. 1 and 5 along the sides of the plenum. In addition, further variation of conditions was possible by completely closing off any combination of outlets; therefore tests could be run with from one to six outlets open.

When any of the foregoing test arrangements was used, one of the five entrance sections shown in Fig. 3 was located at the plenum entrance, that is, just downstream of Station 2 (see Fig. 1). The principal details of these five entrance sections are:

Type 1—Conventional method of introducing air into a plenum, that is, an abrupt expansion condition. The performance of this section was used as the basis for evaluating the performance of the other types.

Type 2—A diverging section 18 in. long. This length was selected as a maximum distance external to the plenum that would be available for corrective devices in many practical applications.

Type 3—The *Type 2* section with seven full-depth splitter vanes installed.

Type 4—An internal expansion ring having five vanes, the entire device being located inside the plenum.

Type 5—An internal expansion section obtained by inscribing a semicircle about the upstream end of the *Type 3* section and placing it inside the plenum.

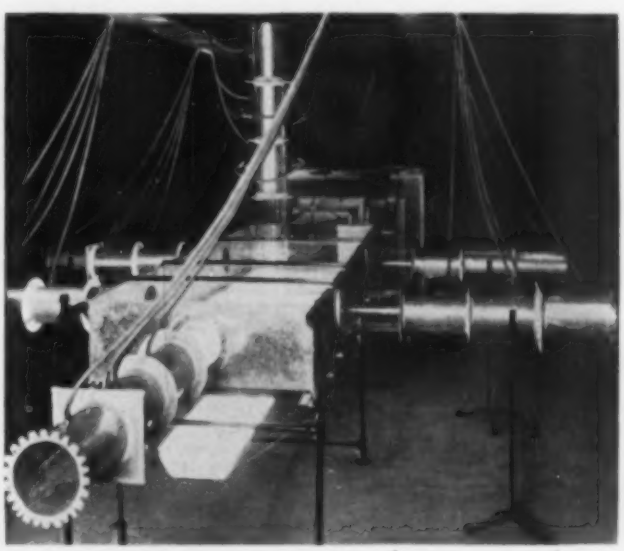


Fig. 2—Photograph of laboratory apparatus for box plenum tests

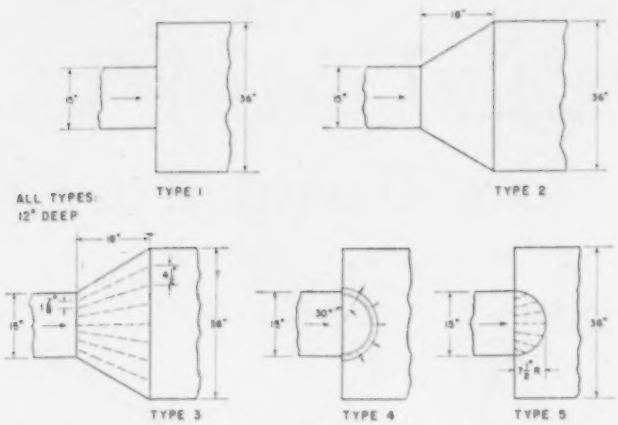


Fig. 3—Plan view of entrance sections studied

Calibration of Equipment

The 16 inclined draft gages were calibrated with an Illinois micromanometer[1] to obtain calibration curves for correcting the gage readings to their true values.

The orifices in the orifice box were calibrated with special equipment. When calibrated, any volume between 80 and 2000 cfm entering the system was determined from the static pressure reading at Station 0. For this volume range, the velocities in the trunk duct leading to the plenum were between 64 and 1600 fpm.

The orifices in the branch outlets were calibrated individually with the branch outlets in their usual positions around the box plenum. During calibration of any one outlet, the other outlets were closed off and the air volume flowing was determined by means of the orifice box. Any outlet volume between 80 and 350 cfm (300-1310 fpm) could then be determined from the pressure differential across the orifice. In addition, the static pressure at the upstream tap (*Example:* Station 51 of outlet No. 5 in Fig. 1) was recorded during calibration to determine an outlet resistance calibration curve for each outlet with the damper *removed*.

[1] Exponent numerals refer to References.

Table 1—Box Plenum Tests

Test Series	Fan Position	Entrance Section	Types of Tests	Number of Outlets Open	Remarks[a]
A	Special	Special	Calibration	One	Calibration of orifice box and outlet orifices.
B	Remote	Type 1	Basic 1, 2, 3, 4	Six	Rotation occurred. Duplicate tests for C and CC flow required.
C	Close Coupled	Type 1	Basic 1, 2	Six	Rotation occurred. Duplicate tests for C and CC flow required.
D	Remote	Type 2	Basic 1, 2, 3, 4	Six	Rotation occurred. Duplicate tests for C and CC flow required.
E	Remote	Type 3	Basic 1, 2, 3, 4	Six	No rotation.
F	Remote	Type 4	Basic 1, 2, 3, 4	Six	Rotation occurred. Duplicate tests for C and CC flow required.
G	Remote	Type 5	Basic 1, 2, 3, 4	Six	No rotation.
H	Remote	Type 5	Basic 1, 2	Six	No rotation. Outlet No. 1 located 7 in. from upstream corner of plenum.
I	Remote	Type 5	Basic 1, 2	Six	No rotation. Outlet No. 1 located 15½ in. from upstream corner of plenum.
J	Remote	Type 5	Basic 1, 2	Six	No rotation. Outlet No. 1 located 11 in. from upstream corner of plenum.
K	Remote	Type 5	Basic 1, 2	Six	No rotation. Outlet No. 1 located 21 in. from upstream corner of plenum.
L	Remote	Type 5	Basic 1, 2	Six	No rotation. Outlets No. 1 and No. 5 located 7 in. from upstream corners of plenum.
M	Remote	Type 5	Basic 1, 2	Varied	No rotation.
N	Remote	Type 5	Special	Six	Three separate piezometer rings formed by Station 3, 4, 11, and 12; Station 5 and 10; and Station 6, 7, 8, and 9.
O	Remote	Type 5	Basic 1	Varied	No rotation.
P	Remote	Type 5	Basic 1	Varied	No rotation.
Q	Remote	Type 5	Basic 1 and Special	Varied	No rotation. Piezometer ring formed by Station 6, 7, 8, and 9.

[a] Rotation—For several tests, the entering air flowed down one side of the plenum instead of expanding and completely filling the plenum section near the entrance. This condition was designated as Clockwise (C) or Counterclockwise (CC) Rotation, depending upon the direction of the air flow around the plenum as viewed from above. For example, when CC rotation occurred, the air stream from the entering duct fed outlet No. 1, 2, 3, 4, and 5 in order.

General Test Procedure

For any given test arrangement, the total volume was varied over the range of 100 to 350 cfm per outlet in about six steps. Before each test, calculations were made of the correct gage readings required to furnish the respective total volume desired for each step. Each of these volumes was then obtained by adjusting the fan speed until the desired value of the static pressure at Station 0 was established. The static pressures of Stations 0, 2, 11, 21, 31, 41, 51, and 61, and the pressure differentials across the outlet orifices were recorded.

Since one or more of four standard test conditions were produced in a majority of the various test series, these four conditions have been designated as *basic tests* and are as follows:

Basic Test 1—Unbalanced; all dampers removed. The equivalent length of each outlet was then 54 ft with 175 cfm flowing.

Basic Test 2—Balanced to obtain equal outlet volumes. Modification of *Basic Test 1* with minimum dampering, that is, at least one outlet left as in the *Basic Test 1*.

Basic Test 3—Unbalanced; additional equivalent length of 46 ft added to each outlet by means of the damper. The total equivalent length of each outlet was then 100 ft with 175 cfm flowing.

Basic Test 4—Balanced to obtain equal outlet volumes. Modification of *Basic Test 3* with minimum dampering, that is, at least one outlet left as in the *Basic Test 3*.

The test series completed, together with supplementary information, are shown in Table 1.

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Analysis of Losses

The system pressure loss in any arrangement consisting of a box plenum and ducts is composed of the

1. Entrance loss as the air enters the plenum.
2. Turbulence loss within the plenum.
3. Outlet loss as the air flows from the plenum into the branch outlet.
4. Duct loss, including registers.

For purposes of this investigation, Station 2 (see Fig. 4) represented the beginning of the system under consideration; therefore, when the total pressure at Station 2 above atmospheric pressure was evaluated for any test it represented the system loss for that test arrangement, namely, the sum of the losses of items 1 through 4.

The sum of the pressure losses in items 1, 2, and 3 can be considered as representing the *total loss* of the plenum, and can be evaluated by subtracting the duct loss (item 4) from the total pressure measured at Station 2. This duct loss (item 4) was determined from the total pressure at Station n1.* Since duct losses in general can be determined by methods in common use, the duct losses of the branch outlets were incidental to the main objectives of this investigation. The total loss was then expressed as

$$L_t = (TP)_2 - (TP)_{n1} \quad \ldots\ldots (1)$$

in which

L_t = total loss of the plenum, sum of items 1, 2, 3.

$(TP)_2$ = total pressure at Station 2, sum of items 1, 2, 3, 4.

$(TP)_{n1}$ = total pressure at Station n1, item 4.

By methods discussed in detail in Appendix A, it was possible to evaluate the outlet loss (item 3), one of the three components in the total loss as determined from Equation 1. The outlet loss could be expressed as

$$L_o = 0.45(VP)_n \quad \ldots\ldots\ldots\ldots (2)$$

in which

L_o = outlet loss at the entrance into any branch duct, item 3.

*n is a general symbol for the number assigned to any outlet for reference purposes only. *Example:* for outlet No. 2, *Sta. n1* would be written *Sta. 21.*

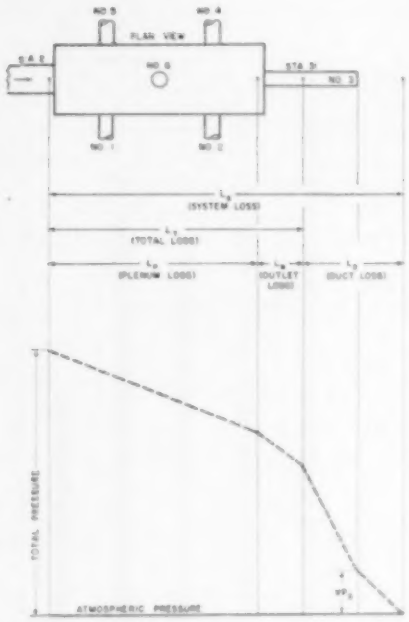

Fig. 4—Description of losses occurring in box plenum

$(VP)_n$ = velocity pressure at Station nl.

When this outlet loss, Equation 2, was subtracted from the total loss of the plenum, Equation 1, the result was defined as the *plenum loss.* The plenum loss, which was the sum of the entrance and turbulence losses, could therefore be expressed as

$$L_p = L_t - L_o \quad \ldots\ldots\ldots\ldots\ldots (3)$$

in which

L_p = plenum loss, sum of items 1 and 2.

An investigation of the factors affecting the entrance and turbulence losses resulted in the conclusion that they depend upon each other and are not logically separable. The investigation consisted, therefore, in evaluating the plenum loss L_p and the outlet loss L_o for a large number of arrangements of the plenum and branch outlets.

Since the six branch outlets were similar in construction, they were expected to deliver equal volumes. However, when a balanced distribution was not obtained, the dampers in the branch outlets were used to equalize the flow from each outlet. Thus the box plenum system was balanced in exactly the same manner as any air distribution system would be balanced in the field. The additional pressure required to balance the system was designated as the *balancing loss.* This was represented by the *difference* in pressure requirements for balanced and unbalanced tests, designated as *Basic Tests 2* and *1,* respectively. Although the balancing loss would ordinarily be considered as part of the duct loss (item 4), it can be appropriately considered as part of the plenum loss, since the amount of additional pressure required for balance depends upon the pressure loss and air flow characteristics of the plenum.

As will be discussed in a later section of this paper, the pressure loss in the plenum, including the balancing loss, was materially affected by the design of the expansion section at the entry of the box plenum. Since the losses to be evaluated for *balanced* test conditions included the balancing loss, the results of *Basic Test 2,* (the balanced tests) were expected to provide a better index of the performance of the box plenum than the results of *Basic Test 1* (unbalanced tests).

The losses shown in the foregoing equations were measured in inches of water; consequently, any given loss was necessarily associated with a particular volume or velocity. Therefore, the losses were more conveniently expressed as the *number of velocity heads lost* by dividing the loss in inches of water by the velocity head corresponding to the velocity flowing, also in inches of water. This number, being dimensionless, was then independent of any volume or velocity. For example, if Equation 2 is divided by $(VP)_n$, the number of velocity heads lost is 0.45; and this value is applicable for any volume flowing in the outlet.

Performance with Abrupt Expansion Entrance Section (Type 1)

a. Plenum Losses. The results of the *Basic Tests 1* and *2* of Series B indicated that the plenum loss was 1.17 velocity heads in the inlet duct for unbalanced conditions and was increased to 1.77 velocity heads in the inlet duct when the system was balanced for equal flow from each outlet.

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The plenum loss under balanced conditions is more than *five times* the abrupt expansion entrance loss obtained from current literature.[2,3] Since no published data are available for evaluating the turbulence loss within a plenum, the entire plenum loss is generally assumed to be represented by the entrance loss alone. The results of this investigation show clearly that this is a dangerous assumption, because the entrance loss obtained from the literature represented less than 20 percent of the actual loss which occurred within the plenum.

b. Rotational Flow. During the test series conducted with the *Type 1* entrance section and with the fan in both the remote and close coupled positions, the silk directional indicators showed a definite rotation of the air within the plenum in either the clockwise or counterclockwise direction. The particular direction of rotation which would occur could not be predicted in advance of a test.

The effect of this rotation on the distribution of air to the outlets was of considerable importance, because the amount of air going to each outlet depended upon the location of the outlet with respect to the rotating stream. Moreover, the flow could be readily changed from clockwise to counterclockwise rotation, or vice versa, thus upsetting the former distribution. For example, outlet No. 1 delivered more air than No. 5 when counterclockwise rotation occurred in the *Basic Test 1* (unbalanced) tests. However, when No. 1 was closed off for 5 to 20 sec, the direction of rotation shifted to clockwise and was stable in that direction, even when No. 1 was reopened. Outlet No. 1 then delivered only 80 percent of its former volume.

Because of the unequal distribution of the air to the outlets during the unbalanced tests, high resistances had to be imposed upon the favored outlets with the dampers to bring the system into balance at equal outlet volumes; consequently the system had a high balancing loss. Moreover, when the system was balanced for a given direction of rotation, it would become unbalanced if the direction of rotation changed.

With respect to the pressure losses, tests indicated that they were the same irrespective of the direction of rotation. Furthermore, the distribution of the air to the outlets was *symmetrical;* for example, if outlets No. 1 and 5 (see Fig. 1) delivered 180 and 150 cfm, respectively, during counterclockwise rotation, they would deliver 150 and 180 cfm, respectively, during clockwise rotation.

The impossibility of obtaining reliable design data for such an unstable system is apparent. Furthermore, the use of the *Type 1* entrance section in field applications should be avoided, since the balance could conceivably be upset by stopping and restarting the fan or temporarily closing off a register.

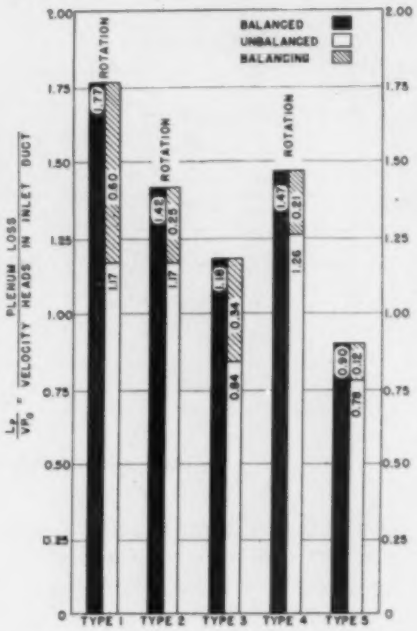

Fig. 5—Plenum losses with five types of entrance sections

c. Effect of Adding Equal Resistance to Each Outlet. The purpose of the *Basic Tests 3* and *4* was to determine the effect of adding equal resistance to each outlet upon the pressure loss and air flow characteristics of the box plenum. The results of these tests were compared with those of *Basic Tests 1* and *2*. This comparison showed that the total pressure at Station 2 was higher by an amount equivalent to the resistance added. However, the calculated total losses were the same for the *Basic Tests 1* and *3*, and also for the *Basic Tests 2* and *4*. It was therefore concluded that the total loss of the plenum was unaffected by the addition of equal resistances to each outlet. Also, the added resistance had no perceptible effect upon the air flow characteristics: the individual outlet volumes were comparable and rotational flow occurred.

d. Effect of Fan Discharging Directly Into Plenum. The Series C tests were conducted with the close coupled test arrangement in order to investigate the effect of the fan discharging directly into the plenum. The previous tests with the remote fan position (Series B) were duplicated to provide direct comparison of results. The system loss with the fan in the close coupled position was slightly greater than the corresponding loss in the remote position. However, for all practical purposes, the losses can be considered the same for either test arrangement. Furthermore, the distribution of the air to the outlets was the same, and rotational flow occurred during both test series.

Comparative Performance of Five Entrance Sections

Since the use of the abrupt expansion section (*Type 1*) resulted in high losses and unstable flow conditions, four additional entrance sections (Fig. 3) were developed and tested. The plenum losses are shown in Fig. 5. These results were obtained from the *Basic Tests 1* and *2* with all six outlets open.

It may be noted that rotation occurred with *Type 1, 2,* and *4*. As previously discussed, the use of any entrance section which results in rotational flow should be avoided.

The effect of adding equal resistances to each outlet was also investigated with *Type 2, 3, 4,* and *5*. The results indicated that the plenum loss alone was not affected. This result agreed with that obtained with the *Type 1* section.

The following factors were selected for evaluating the performance of any entrance section:

1. The plenum loss under balanced conditions.
2. The additional pressure required to balance the system.
3. The stability of the system, or the ability to maintain fixed flow rates.
4. The space requirements external to the plenum.

The *Type 5* entrance section was superior to the others in all of these respects, and was therefore studied in greater detail.

Performance with Type 5 Entrance Section

A number of test series were conducted with the *Type 5* section to investigate the effect of moving one or more outlets, and the results are presented in Fig. 6. The total loss of the plenum increased considerably when the outlet was located closer than approximately 12 in. from the corner of the plenum. Therefore, the centerline of any outlet should be more than 12 in. from the corner if excessive pressure losses are to be avoided.

An additional test series was conducted with both outlets No. 1 and 5 located seven inches from the cor-

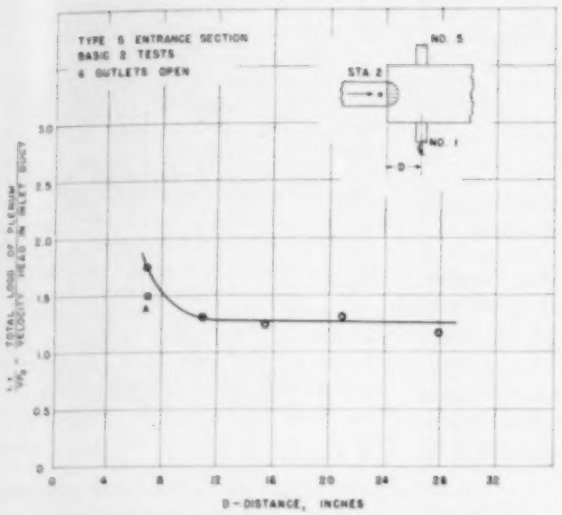

Fig. 6—Effect of outlet location on pressure loss of box plenum

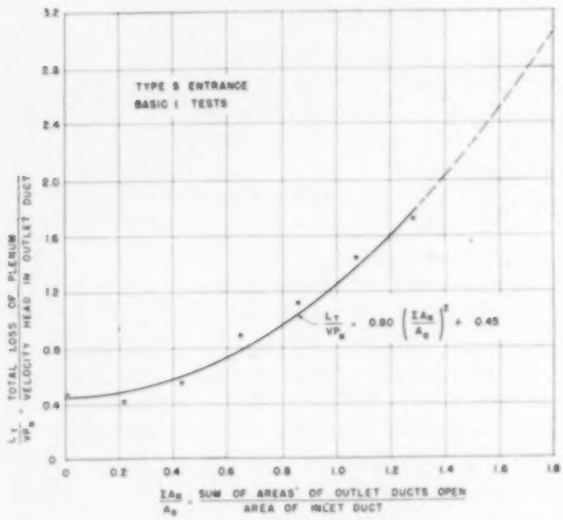
TYPE 5 ENTRANCE
BASIC 1 TESTS
TOTAL LOSS OF PLENUM
VELOCITY HEAD IN OUTLET DUCT
SUM OF AREAS OF OUTLET DUCTS OPEN
AREA OF INLET DUCT

Fig. 8—Total loss of plenum with variable ratios of outlet to inlet area

ner of the plenum. As indicated by point A in Fig. 6, the total loss is less under these conditions. This indicates that a symmetrical location of outlets is desirable when a distance D of less than 12 in. must be used. For a distance D greater than 12 in., the performance of the system is not affected by the relative locations of outlets.

The effect of varying the number of outlets open was also investigated. The relationships of the static pressures and air volumes are shown in Fig. 7. Since for any given number of outlets open numerous combinations were possible, several representative combinations were tested for each condition. The static pressure requirements were found to be independent of the particular outlets open in any one combination.

From the data of Fig. 7 and the equations developed in Appendix B, the curve of Fig. 8 was derived. The plotted points, as compared with the curve, represent deviations of less than three percent in the test data.

The equation of this curve, which represents the *unbalanced flow condition,* can also be expressed

$$L_t = 0.80(VP)_o + 0.45(VP)_o \quad . (4)$$

in which

L_t = total loss of the plenum, inches of water.

$(VP)_o$ = velocity head at Station 2, inches of water.

$(VP)_o$ = velocity head at Station nl, inches of water.

The total loss, therefore, can be expressed as the sum of a function of the velocity head in the entrance duct and a function of the velocity head in the outlet duct. The term $0.80(VP)_o$ represents the plenum loss L_p, and the term $0.45(VP)_o$ represents the outlet loss L_o. The plenum loss includes the entrance and turbulence losses; however, as previously stated, these two losses depend on each other and cannot be logically separated.

For the *balanced flow condition,* an equation similar in form to Equation 4 can be derived. In this connection, the balancing loss with the *Type 5* section (see Fig. 5) was extremely small with all six outlets open. Moreover, as the number of outlets open was reduced, the balancing loss became progressively less—in fact, it was necessarily zero when only one outlet was open. Therefore, the data obtained with all outlets open were used to derive an expression for the total loss for the balanced flow condition, as follows:

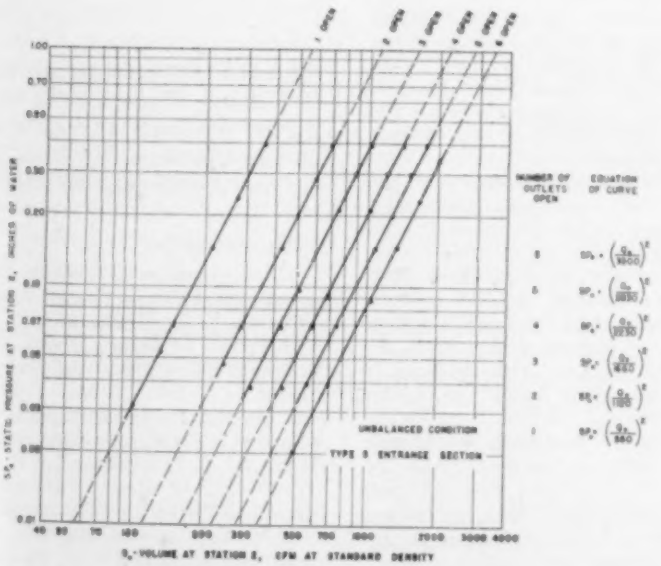
NUMBER OF OUTLETS OPEN
EQUATION OF CURVE
UNBALANCED CONDITION
TYPE 5 ENTRANCE SECTION
Q - VOLUME AT STATION 2, CFM AT STANDARD DENSITY

Fig. 7—Variation of static pressure and volume at station 2 with number of outlets open

$$L_t = 0.90(VP)_o + 0.45(VP)_a \quad .(5)$$

This equation is recommended for use with the *Type 5* entrance section, *provided* no outlet is located within 12 in. of the upstream corners of the plenum.

Equations 4 and 5, which were derived from curves having dimensionless ordinates, have a definite possibility of being extrapolated to other sizes of inlet and outlet ducts and to larger numbers of outlets open. Additional tests are in progress to investigate this possibility.

The favorable performance characteristics of the *Type 5* entrance section can be summarized as follows:

1. The plenum loss under balanced conditions was only 51 percent of that for the *Type 1* section.
2. The additional pressure required to balance the system was very small.
3. The stability of the system was excellent, since no rotational flow occurred or could be made to occur.
4. The space requirement was a minimum, since the entrance section occupied no space external to the plenum.
5. The section was easily fabricated and installed.

Because of these favorable characteristics, this section is recommended for use, and the necessary construction details are shown in Fig. 9.

General Equation for Total Loss

The relations expressed in Equations 4 and 5 can be used to develop a general equation for the total loss of a box plenum, which is

$$L_t = K_o(VP)_o + K_a(VP)_a \quad \ldots (6)$$

in which

L_t = total loss of any box plenum, inches of water.

K_o = a constant which depends on factors such as the entrance section, amount of turbulence within the plenum, and the physical dimensions of the plenum.

K_a = a constant which depends upon the performance of the plenum take-off fitting.

$(VP)_o$ = velocity head in the entrance duct, inches of water.

$(VP)_a$ = velocity head in any outlet duct, inches of water.

For the branch outlets used in this investigation, K_a has been evaluated as equal to 0.45. For the five entrance sections investigated, the values of the balanced plenum losses shown in Fig. 5 are also values of K_o. Therefore, the total loss equations for the five types of entrance sections, for balanced flow conditions, are as follows:

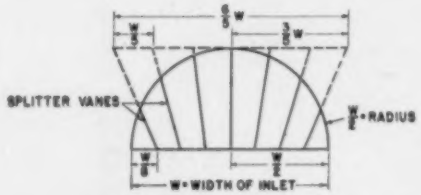

Fig. 9—Construction details of type 5 entrance section (plan view)

$$\textit{Type } 1 — L_t = 1.77(VP)_o + 0.45(VP)_a \quad \ldots (7)$$

$$\textit{Type } 2 — L_t = 1.42(VP)_o + 0.45(VP)_a \quad \ldots (8)$$

$$\textit{Type } 3 — L_t = 1.18(VP)_o + 0.45(VP)_a \quad \ldots (9)$$

$$\textit{Type } 4 — L_t = 1.47(VP)_o + 0.45(VP)_a \quad \ldots (10)$$

$$\textit{Type } 5 — L_t = 0.90(VP)_o + 0.45(VP)_a \quad \ldots (5)$$

In order to investigate the applicability of Equation 6 to other sizes and types of plenums, additional tests are in progress with a three-foot long box plenum.

Conclusions

1. The total pressure loss associated with a box plenum is composed of an entrance, turbulence, and outlet loss. The entrance and turbulent losses cannot be logically separated.
2. The pressure loss at the entrance to the branch outlets is in good agreement with the generally accepted value.
3. The pressure losses and air flow conditions within a box plenum are not affected by the addition of equal resistance to each outlet.
4. For all practical purposes, the losses with the remote and close coupled fan positions are the same. Therefore, the results will apply to field conditions when the fan is located very close to the plenum.
5. Take-off fittings for branch outlets should not be located within 12 in. of the upstream corners of the plenum if excessive balancing losses are to be avoided.
6. The plenum loss with the abrupt expansion entrance section *(Type 1)* installed is much higher than the calculated entrance loss alone, indicating the loss due to turbulent mixing in the plenum is severe.
7. Unless the entrance section of a box plenum is carefully designed, large pressure losses and unstable distribution of air to the branch outlets will result.
8. When the *Types 1, 2,* and *4* entrance sections were used, rotational flow occurred and the system was unstable. The use of these three types should be avoided.
9. The *Type 5* entrance section is superior to the other types tested from the standpoint of total loss, pressure required to balance the system, stability of the system, and space requirements. This section is recommended for use in the field. The plenum loss with this section can be taken as 0.90 velocity heads in the inlet duct, provided no branch take-off is located within 12 in. of the upstream corners of the plenum.

Acknowledgment

On October 1, 1947, the *American Gas Association,* Committee on Domestic Gas Research, as part of the Association's comprehensive research program (Par Plan, *AGA Project DGR-2-AC*) entered into an agreement for cooperative research with the Engineering Experiment Station at the University of Illinois, the objective being the improvement of air distribution systems for gas year 'round air conditioning. This paper is a progress report of the initial laboratory investigations of box-type plenums. The laboratory work represents one phase of the overall research program.

Acknowledgment is made to the *AGA* Technical Advisory Group for Gas Summer Air Conditioning Research, for the advice and counsel received, and to W. K. Ender and G. W. Wilson, former graduate students at the University, for services rendered in collecting and reducing test data. These results will ultimately comprise part of a bulletin of the University of Illinois Engineering Experiment Station.

References

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2. Pressure Losses Resulting from Changes in Cross-Sectional Area in Air Ducts, by A. P. Kratz and J. R. Fellows. (University of Illinois *Engineering Experiment Station Bulletin No. 300,* 1938.)

3. Modern Air Conditioning, Heating and Ventilating, by W. H. Carrier, R. E. Cherne, and W. A. Grant. (Pitman Publishing Corp., 1940, p. 236.)

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DISCUSSION

F. L. MEYER and J. J. BOLAND, Peoria, Ill. (WRITTEN): The authors are to be commended for the detailed study of the air flow characteristics within a box plenum. Obviously, a great deal of careful thought and effort have gone into the making of this report and the practicability of the proposed method is gratifying. The use of a box plenum, in which the results were assured to be stable, would be of great assistance in design of overhead supply ducts or central air distributing compartments in the applications mentioned.

According to Table 1, assured results are dependent on the use of entrance section Type 3, or its modified version Type 5, to obtain non-rotational flow within the box plenum.

It would appear that the tests with these entrance sections were not carried far enough to assure stability in all cases. Tests were conducted on Type 1, both remote and close-coupled, and the results indicated that the characteristics were very similar. To make the close-coupled test, it was necessary to remove the egg-crate straighteners and the resistance plate. Both of these items help to produce a uniform velocity contour as the air approaches the entrance section. It would be interesting to know if an investigation was made of the velocity contour at Station 2 to show whether the velocity contour was uniform and the rotation in the box plenum was produced by the rapid expansion of air into the box plenum. The successful use of the entrance section, Type 3 or Type 5, would appear to be dependent upon the uniform velocity contour approaching the entrance section produced by the egg-crate straighteners or the resistance plate. If the velocity contour approaching the entrance section, Type 3 or Type 5, should not be uniform due to close-coupling of heating or cooling equipment or an elbow upstream of the box plenum, the air flow in the box plenum may also be unstable. If tests prove this to be the case, the use of egg-crate straighteners or a resistance plate may be required to produce a uniform velocity contour. This would impose additional resistance in the system and increase the box plenum loss.

C. S. LEOPOLD, Philadelphia, Pa., inquired whether measurements of sound reduction were actually made or were observed by ear.

JOHN EVERETTS, JR., Philadelphia, complimented Mr. Gilman on his excellent presentation of the paper, and remarked that the subject was of importance in the design of heating and air conditioning systems. He asked whether the resistance would change with other ratios of A_1 to A_2, if the four sides of the entrance duct were effective for expansion, and if the entrance duct were the same depth as the plenum. He also suggested that the work be continued, particularly with reference to exhaust plenums and plenum intakes for fans.

R. J. MARTIN, Urbana, Ill., made the concluding remarks for the authors.

INTELLIGENCE VOTED MOST DESIRABLE QUALITY IN ENGINEERING EMPLOYEES

The intelligent person, meaning the one who thinks clearly, is the most desirable in the engineering profession, according to results of a survey of 1033 engineering executives, college administrators, personnel officials, instructors and students. The survey was conducted over a period of three years by the Engineers Council for Professional Development.

The second most favorable quality in an engineer, the survey reported, was voted to be *dependability*. Organizational acceptability was third, with *energy* and *emotional acceptability* as fourth and fifth. *Physical acceptability* ran sixth in the voting.

However, where salesmanship or distribution departments of industry were concerned, qualities needed for success were different from those voted necessary in the research and design phases of engineering. In sales and distribution, the replies listed *dynamic* as the greatest personality asset, with *physical acceptability* as a close second.

There was general agreement in the meanings of the traits. For all, the intelligent man was one who was clear thinking, and the dependable person was one who was truthful but not necessarily one who could get things done. *Organizational acceptability* meant *cooperativeness* and *consideration*. On the other hand, the term *dynamic* was defined in so many ways that no single meaning stood out.

DISPERSION OF GASES FROM TALL STACKS AS A MEANS OF POLLUTION CONTROL*

Extensive data covering fifteen years of continuous recording of sulfur dioxide concentrations at fixed stations near two smelting plants are analyzed in the light of the equations of Bosanquet and Pearson and Sutton. At Selby, Calif. a single recorder measured the ground concentrations from a 150-ft stack, which was later replaced by a 605-ft stack. The recorder was 90 stack lengths from the first stack and 23 from the second. There was a clear path from the stack to the recorder. At Garfield, Utah, three recorders operated at 65 to 85 stack lengths from the plant and the smoke usually had to pass over a ridge 1500 ft above the stacks and recorders.

At Selby the ratios of maximum recorded concentrations, C, to mass emissions, M, of sulfur dioxide from both stacks agreed well with the Bosanquet and Pearson formula, assuming the point of maximum ground concentration (not measured) was at 10 to 15 stack lengths. The maximum C/M ratios for the short stack averaged three times those of the tall stack. They usually occurred about noon with wind velocities of 8 to 10 miles per hour.

At Garfield these ratios also agreed well with the Bosanquet and Pearson formula despite the obstructions in the terrain. The dilution factor between the recorders was somewhat greater than the inverse square.

It seems improbable that Sutton's analysis, which suggests much greater distances for the point of maximum ground concentration than 10 to 15 stack lengths, could apply to these data.

*Paper by Moyer D. Thomas, G. R. Hill, and J. N. Abersold, American Smelting and Refining Co., presented before the 115th meeting of the *American Chemical Society* at San Francisco, Calif., March 27, April 1, 1949.

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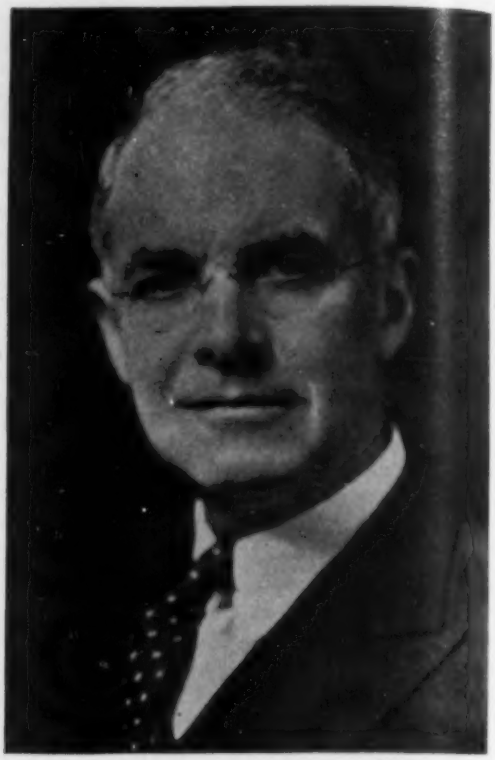
Proceedings ASHVE

Semi-Annual Meeting

Minneapolis, Minn.

June 20-22, 1949



President A. E. Stacey, Jr.

FOUR hundred members and guests came to Minneapolis to participate in the 1949 Semi-Annual Meeting of the Society, June 20-22, and to enjoy the hospitality of Minnesota Chapter in an extensive program of inspection trips, sightseeing and entertainment. Ten papers were presented and discussed at three well attended technical sessions.

First Session—Monday June 20, 10:00 a.m.

Pres. A. E. Stacey, Jr., Syracuse, N. Y., called the Semi-Annual Meeting of 1949 to order at 10:00 a.m., in the Nicollet Hotel, Minneapolis, and introduced John E. Haines, Minneapolis, chairman of the Committee on Arrangements. Mr. Haines gave an outline of the preparations which had been made to make the meeting both instructive and pleasant, and then gave the members and guests a cordial welcome to Minneapolis.

President Stacey expressed the appreciation of the Society for the cordial welcome and the careful preparations which had been made by the Committee. He spoke of the close contact which had been maintained between the Society and the University of Minnesota, from which had come the Society's first director of research, Prof. John R. Allen.

J. S. Locke, Minneapolis, Minn., chairman of the Entertainment Committee, outlined the plans which had been made for various types of entertainment for members and guests, their wives and children.

President Stacey read a telegram from Past President, Walter L. Fleisher, New York, N. Y., as follows:

> REGRET MY INABILITY TO BE WITH YOU. HOPE YOU HAVE A VERY ENLIGHTENING AND SUCCESSFUL SESSION.

The chairman then called upon Secretary A. V. Hutchinson, New York, N. Y., to read the amendment proposed to **Article B-XI—Funds**, *Section 7*, of the Society's By-Laws.

Article B-XI—Funds

Section 7. A Society Reserve Fund shall be created into which all admission fees and such other moneys as the Council may direct shall be placed until the fund totals a sum equal to fifteen dollars ($15.00) per member. *or fifty thousand dollars ($50,000) whichever is smaller.* This Reserve Fund is to be used only in cases of emergency when current Society revenues are not sufficient to pay necessary expenses. Withdrawals not to exceed twenty per cent (20%) of the fund in any calendar year may be authorized by the Society at any meeting provided it has been recommended by the Council. Investments shall be made in accordance with **Article B-XI**, *Section 1.* Interest earned on the Reserve Fund shall be added to current Society income.

To be Amended as Follows:

Section 7. A Society Reserve Fund shall be created into which all admission fees and such other moneys as the Council may direct shall be placed until the fund totals a sum equal to fifteen dollars ($15.00) per member. This Reserve Fund is to be used only in cases of emergency when current Society revenues are not sufficient to pay necessary expenses. Withdrawals not to exceed twenty percent (20%) of the fund in any calendar year may be authorized by the Society at any meeting, provided it has been recommended by the Council. Investments shall be made in accordance with **Article B-XI**, *Section 1.* Interest earned on the Reserve Fund shall be added to current Society income.

Adoption of the Amendment was moved by Merrill F. Blankin, Philadelphia, Pa. and seconded by L. E. Seeley, Durham, N. H. Dean Seeley explained that the purpose of the Amendment was to increase the Society Reserve Fund by removing the limitation of $50,000.00 which had been established when the Society had less than one-half of the present membership. The Amendment was adopted unanimously.

The following Committee on Resolutions was appointed by President Stacey: Carl F. Kayan, chairman, New York, N. Y.; J. H. Carter, St. Louis, Mo.; T. D. Stafford, Grand Rapids, Mich.

Air Flow Through Blower and Furnace, Box Plenum, and From Perforated Panels

President Stacey called upon N. A. Buckley, special assistant in Mechanical Engineering, University of Illinois, Urbana, Ill., who presented the paper, **Determining Performance of a Blower Used with a Furnace**, by Mr. Buckley and R. W. Roose, (published in July 1949 JOURNAL SECTION, *Heating, Piping & Air Conditioning*). Mr. Buckley gave a resumé of the paper together with the significant conclusions derived.

D. M. MILLS, Houston, Texas, asked for further comment on the relation between actual fan capacities when installed in the furnace, as compared with manufacturers' published ratings.

The next technical paper on the program was **Air Streams from Perforated Panels**, by Alfred Koestel, Philip Hermann and G. L. Tuve, and was presented by Alfred Koestel, instructor, mechanical engineering, Case Institute of Technology, Cleveland, Ohio, who illustrated his resumé of the paper by means of slides (published in July 1949 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

W. M. WALLACE, II, Durham, N. C., asked whether the authors expected to extend their studies to cover panels of larger areas.

E. J. KUREK, Chicago, Ill., expressed the hope that further data would be obtained on temperature distribution on non-isothermal streams, and that experimental results could be correlated analytically. He cited his own experience in which he had considerable success in using perforated panels varying in size from 2 × 4 ft to 3 × 6 ft at perforation velocities of 150 to 200 fpm. He had found that under these conditions, and with temperature differences up to 20 deg, and with 8 ft ceiling height, the air velocity at or below the breathing level had been below 50 fpm, and the temperature gradients in the same zone had been from one to two degrees.

C. S. LEOPOLD, Philadelphia, Pa., pointed out that the distribution of air through the entire perforated ceiling results in a low average downward velocity and causes a delivery of air into the occupied zone at a temperature higher than would result if the air were delivered through a portion of the ceiling only. This is due to the warming of the entire ceiling by radiation from direct sources of heat, such as light, as well as radiation from walls and floors, and part of this heat absorbed by the ceiling is transferred to the air passing through the perforation.

He also stated that if the perforated heat losses of a building are supplied by means of radiators, the air delivered to the interior of the building will be at or below room temperature even in winter. If less than the full area of the ceiling is used for introduction of air the performance can be judged by comparison with results obtained by use of the entire perforated ceiling.

LESTER T. AVERY, Cleveland, Ohio, cited his experience in using perforated panels for air distribution including not only perforated cells, but duct sections. He had found that air distribution for cooling purposes was very effective when using such panels, and had found also that the panel itself provided some cooling effect.

He assumed that tests had been conducted with no temperature difference between the air stream and the room air, and therefore inquired whether further tests would be conducted with warm or cold air streams for the purpose of determining the effect of temperature and direction of air flow. Such tests should include ejection of air horizontally from side walls of ducts.

MR. AVERY emphasized the importance of keeping holes in perforated panels clean by making certain that the air supplied to such panels in installations had been cleaned by means of filters.

The third technical paper, **Pressure Loss and Air Flow Characteristics of a Box Plenum**, by S. F. Gilman, R. J. Martin, W. R. Hedrick and S. Konzo, was presented by Mr. Gilman, instructor and special research assistant, University of Illinois, Urbana, Ill. (paper and discussion in this issue, see page 114.)

Following the announcement that the Nominating Committee would meet in the North Shore Room at 1:30 p.m., the meeting was adjourned at 12 noon.

Second Technical Session, Tuesday, June 21, 9:30 a.m.

First Vice-President Lester T. Avery, called the meeting to order at 9:30 a.m., and called upon L. N. Hunter, Johnstown, Pa., Chairman of the Committee on Research, who presented a report of the membership interest survey which had been conducted by the Committee on Research.

Research Reports on Member Survey

L. N. Hunter, Chairman

The recent increase in Society membership has brought a number of problems before the Committee on Research regarding the research program. To aid in developing a research program that will be of maximum benefit to the membership, the Committee desired to find out: to what extent the membership, old and new, understood the purpose of Society research and the kind of research permissible under the Constitution; what kind of research the membership really wanted; which parts of the current program were of most interest; what the membership felt about the present methods of getting into their hands the information developed as a result of Society research.

Mr. Hunter said that the first survey of membership interest was conducted by the Committee on Research in 1931 and was analyzed by Prof. A. C. Willard, its Technical Adviser. From the analysis, a list of projects was drawn up, with the results published in the TRANSACTIONS over the past 15 years.

When the Committee on Research decided to undertake another survey late last year, a letter was sent out to over 6500 members of all grades.

Mr. Hunter then quoted from this letter, setting out the questions for

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which the Committee sought an answer. Nearly 1300 replies were received. A Committee consisting of John W. James, vice chairman of the Committee on Research, R. C. Cross, and M. K. Fahnestock made a careful analysis of the votes and of the many comments received.

What Type of Research Program? The three questions dealing with research policies were answered by 1279 members. The questions were answered as follows:

I believe that the Society should:

1. Engage primarily in long-term research.
2. Concentrate on research which has an immediate and direct practical application.
3. Carry on with a program containing both types of research.

Of nearly 1300 replies, 772 members asked for research which included long-term projects and also projects having immediate and direct practical application. Those wishing practical research alone numbered 386, and those advocating only long-term research numbered 121. Thus, the majority of those answering the questions on policy favored a balanced Society research program.

Mr. Hunter then gave some of the comments sent in by the membership, regarding fundamental research, practical research, and long-term *vs.* immediately applicable research.

Presentation of Research Results

How should research results be presented? How many members read the research papers as now presented in the JOURNAL? Could our present methods be improved? How much of what is being done is unknown or imperfectly known because of the way in which it is presented to the membership? These are all very important questions which have gained in importance in recent years and have faced the Committee on Research and every Technical Advisory Committee. It is interesting to see how those replying in this survey voted on these questions, Mr. Hunter stated.

Five hundred and fifteen (515) thought that the Society should present research results, as it has been doing for many years, in the form of technical papers. Five hundred and fifty-seven (557) persons, however, thought that more time might well be spent in putting research results in a form ready for practical application.

Mr. Hunter quoted from comments made regarding the desirability of having technical papers written in more practical form. Comments also suggested that TAC's and individual engineers assist in interpretation of results. Briefer progress reports on research were also suggested in some of the comments.

Responsibility of the Society as in relation to the Committee on Research and to industry was commented on, Mr. Hunter said, with members suggesting that practicing engineers, the Guide Publication Committee or individual members evaluate research data.

A number of members suggested brief periodic progress reports on research under way and activities of the Technical Advisory Committees. Informal monthly bulletins to members outlining research and other Society activities were also suggested.

In this survey the Committee requested the membership to indicate, for its guidance, their ideas on the relative importance of some 33 projects which either formed part of the present research program or were of such a nature that early action might be taken on them. The table below summarizes the voting, and it will be seen that some 70 percent of those returning the forms indicated their opinions on most of the projects.

The Committee report describes the various methods used to analyze the returns, with column 2 being chosen as a measure of the order of interest.

Results of Opinion Survey on ASHVE Research Program

	Total Votes	Would like to see more emphasis in future programs	Are satisfied with present program	Suggest less emphasis in future programs	Order of interest based on Col. 2
Air Distribution					
Friction of fittings	890	204	517	169	31
Performance of outlets	909	418	411	80	7
and intakes	852	336	427	89	16
Ventilation jets	824	284	441	99	24
Effect of approach conditions	814	190	519	105	32
Air flow measurement	891	306	486	99	21
Air Purification					
Air cleaning in ventilation	911	374	475	62	11
Dust control	864	327	476	61	18
Atmospheric pollution	865	318	469	78	19
Air sterilization	910	462	380	68	6
Industrial and exhaust ventilation	871	368	418	85	12
Odors and odor control	893	467	361	65	5
Comfort and Health					
Influence of humidity	926	410	446	70	9
Influence of radiation	901	404	444	53	10
Influence of air purity	894	330	492	72	17
Rapid environmental changes	897	351	460	86	14
Panel or radiant heating	1016	542	390	84	1
Panel or radiant cooling	938	522	315	101	2
Heat pump	956	496	318	142	3
Heating load factors	896	287	527	82	22
Cooling load factors	867	307	494	66	20
Heat transmission through building materials	899	246	539	114	30
Heat capacity of building materials	869	286	495	88	23
Infiltration	894	341	490	63	15
Solar radiation	907	413	436	58	8
Insulation	865	264	526	75	29
Water vapor migration	852	361	423	68	13
Weather design conditions	858	283	486	89	25
Fuels and combustion	869	273	484	112	27
Chimneys and draft	869	269	463	137	28
Moisture control by sorbents	831	274	465	92	26
Noise control	897	470	379	48	4
Psychrometric charts	837	166	543	128	33

The first 15 projects are arranged in order as follows:

1. Panel Heating
2. Panel Cooling
3. Heat Pump
4. Noise Control
5. Odors and Odor Control
6. Air Sterilization
7. Performance of Air Outlets in Air Distribution
8. Solar Radiation Effects
9. Influence of Humidity on Comfort and Health
10. Influence of Radiation on Comfort and Health
11. Air Cleaning in Ventilation
12. Industrial and Exhaust Ventilation

13. Water Vapor Migration
14. Effect of Rapid Environmental Change on Comfort and Health
15. Infiltration

Since slightly different methods of analysis might easily change the order of individual projects by several points, it is the trend which is significant and the fact that almost any method of analysis groups certain projects together in their importance to the membership.

Complete Returns

A detailed analysis of the votes and comments has been supplied to all members of the Committee on Research. Each member of a Technical Advisory Committee has received the summary and a breakdown of votes and comments on subjects within the Committee's scope. Copies of the complete report in mimeographed form will be supplied by the Laboratory to any member requesting one in writing. Some of the more frequent comments are the following:

Air Distribution

More data are needed on (1) ceiling diffusers, (2) the effect of outlet location on temperature distribution in the conditioned space, (3) high velocity air distribution systems.

Air Purification

Criteria should be developed for performance of air cleaning devices, air purification equipment (germicidal) and odor removal equipment.

Air Sterilization

More work is needed on year-round air conditioning for sufferers of respiratory diseases, asthma, and hay fever. Efforts to reduce air pollution will increase the Society's prestige in the eyes of the public.

Combustion

Data are required on domestic chimneys. Studies should be made on heat transfer between flue gases and air and/or water.

Cooling Load

Solar heat gain data should be simplified and clarified and the effect of shading devices studied.

Heating Load

There is need for more accurate methods of calculating heating loads by infiltration through windows of all kinds into multi-storied buildings and in residences. Additional data are needed on wind effects on all types of heated structures. Floor losses and basement losses need additional study. The Society should publish a standard form for calculating heating and cooling loads.

Heat Pump

Basic research is needed on the extraction of heat from water, air and ground for use in heat pump design. A survey of underground heat sources would be worth-while.

Industrial Ventilation

More work is needed in the field of industrial and occupational hazards due to atmospheric conditions, ventilation of foundries, chemical plants, garages, etc. Dispersion of exhaust gases and fumes from industrial chimneys should be studied.

Insulation

Data are needed on insulation of heated and unheated floor slabs in basementless houses. Information is needed on water vapor migration through, and moisture adsorption by, ordinary building materials.

Odors

Effects on human comfort of odors in air conditioned spaces should be studied.

Panel Heating and Cooling

Highly divergent data should be coordinated and data developed concerning comfort and health with panel heating.

Physiological Research

More information is needed on the effect on people of their atmospheric environment. Little is known about the degree to which comfortable conditions affect health, susceptibility to respiratory illness, mental and physical productivity of individuals, or about the psychological effect of varying electrical conditions of the atmosphere.

Correct the comfort chart for influence of radiation.

The Society's position has been established by its research in connection with human reaction to environment.

Sound Control

Standards on noise and sound intensity should be developed.

Weather Design Conditions

More data are needed on climatic conditions for Canadian cities, California desert areas, South America and important cities in Mexico.

The average heating system is based on the *lowest* external temperature in a region, the result being a system sized to take care of these worst conditions which is costly.

Conclusion

The Committee on Research appreciates the cooperation extended by Society members. Many constructive suggestions were received which will serve as a valuable guide in the formation of future research policies and programs.

The Committee on Research wishes to thank Messrs. James, Cross, and Fahnestock, and the Laboratory staff for their analysis of the comments received.

Heat Source and Operation of Heat Pump

Mr. Avery introduced E. W. Guernsey, director of research, Consolidated Gas Electric Light & Power Co., Baltimore, Md., who presented the paper, **Earth as a Heat Source or Storage Medium for the Heat Pump**, by Dr. Guernsey, P. L. Betz and N. H. Skau (published in May 1949 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

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E. P. PALMATIER, Syracuse, N. Y., remarked that the authors had made a definite contribution to the theory of heat pump exchanges by presenting their material in such clear and usable form. He quoted some examples which indicated that the use of a ground coil could be practicable, although the conclusion to be drawn from the authors' paper would be that the ground coil is economically impracticable. He felt that some other theory rather than one involving simple heat capacity and conduction should be used if moisture is frozen in the soil around a heat pump coil. From an illustration and calculations which he presented, he concluded that if soil contained a considerable amount of moisture, sufficient heat for one heating cycle would be available from a distance of not more than two or three feet from the buried tube.

He referred to a suggestion which had been made by Prof. C. H. Coogan, Jr., University of Connecticut, Storrs, Conn., in a publication, *The Residential Heat Pump in New England*, that the most economical horizontal ground coil design would probably always result in some freezing of moisture during periods of peak heating load. It was therefore necessary to have, for the purpose of designing ground coils, a composite theory of design which would include both the thermal capacity and heat conduction of unfrozen soil, and the freezing of moisture in the soil.

C. W. BROWN, Bloomfield, N. J. (WRITTEN): I agree with the authors' conclusion that as much attention as possible should be given to the study of means of minimizing the difficulties in the use of other heat sources, especially air.

My reasons for agreement are largely independent of the reasons given by the authors and are based on the sometimes unanswerable problems that face the application engineer considering the ground as a heat source. He wonders:

1. What is the probable heat transfer rate of the soil?
2. Are there rock strata that will interfere with placement of a ground coil?
3. Will too much sales resistance be created if he asks the owner to permit digging up his lawn, flower garden, drive or placement of the ground coil under the foundation?
4. Does the customer own sufficient land area to permit placement of a ground coil large enough to heat the building?
5. How much will it cost to detect and correct leaks in the ground coil?

Since the application engineer considering air as a heat source faces none of these questions, he may logically prefer, and use his influence, to swing the job to air as a heat source. He might prefer air as a heat source because:

1. Heat transfer rates are known when air is used as a heat source.
2. Air is universally available.
3. No sales resistance is created through the use of air.
4. Leaks are in visible locations and detected and corrected by means familiar to the refrigeration industry.

It is significant that at the last meeting of the ASHVE Technical Advisory Committee on the Heat Pump members voted to emphasize heat source investigation in the following order: (1) air; (2) earth; (3) solar; (4) ground water; and (5) surface water.

J. DONALD KROEKER, Portland, Ore. (WRITTEN): An Oregonian has undoubtedly been requested to comment on this paper because residential heat pumps in Oregon using earth as a heat source have received national publicity through news services and coast-to-coast radio hook-ups, informing the world that these applications have been failures.

There were some mis-applications following the postwar heat pump hysteria. Most of the Oregon firms which sprang up overnight to fill the demand —and unfortunately to promote it, too— are now bankrupt. A number of installations have been converted to oil. Yet there are also more than a simple majority of these installations which operated satisfactorily throughout the 1948-49 winter, Oregon's longest and coldest heating season.

This paper presents an analysis which is a very logical presentation of known mathematical formulas and soil conductivities. However, some conclusions seem open to question, on the basis of observations in installations using earth as a heat source.

Some of the difficulty in checking the figures derived mathematically against the results obtained in practice can lie in the fact that the mathematical analyses are based upon conductivities, while the results obtained in practice depend to a large extent on transfer factors other than conductivity. Whether it is conduction or convection which actually transfers the heat from one point to another in the ground may be open to discussion. The fact remains that, in many soils with a 20 to 30 percent moisture content, a heat transfer rate of 2 to 10 Btu per (sq ft) (hr) (F deg) is often obtained.

Almost every engineer dealing with ground source heat pumps has gone through conductivity calculations to determine the amount of surface required and has obtained an answer which made use of a ground source for the heat pump impracticable. Yet there are many heat pumps operating today with ground coils having surfaces a small fraction of those indicated from calculations. It is also true that some of the ground coils do not operate satisfactorily. Where the coils have been unsatisfactory one or both of two conditions were found to exist. First, an absence of moisture or moisture movement in the soil, due either to the impervious nature of the soil or due to dry weather; second, concentration of the coil in a limited volume of soil such that the ground froze and expanded to an extent that caused extensive damage. In all cases the amount of ground coil used was only a fraction (generally, 15 to 30 percent) of the amount indicated as required by conductivity calculations.

A third factor which has caused trouble with ground coils in Oregon has been their location too far below the surface of the earth. A possible explanation of this phenomenon is the observed fact that, where average winter temperatures are in the neighborhood of 40 to 45 F and an evaporator temperature of 20 F is maintained, the temperature of ground will increase 5 to 10 deg in a few days of rainy weather after a cold dry spell during which the entire area covered by the ground coil has dropped to freezing temperatures.

There is still much to be learned about ground coils, but experience with them to date indicates that, in soil which allows free movement of moisture, both liquid and vapor, located in areas with mild, wet winters, the ground coil can operate successfully and be reasonably economical to install. This is true even where the soil is not used as a heat sump.

Studies of heat pumps actually using ground coils are needed. Much data are being assembled on such installations and should be coordinated. Oregon Chapter has in progress its own un-subsidized, fully-instrumented research project on one such ground coil installation on which data from a full year of operation should be available next year.

Finally, the paper is a sound analysis only of conductivity of earth but not an analysis of practical application of a coil located in earth to withdraw heat therefrom. It will serve, too, as a means of attracting the designer's attention to the very real limitations which must be considered in using dry earth as a heat source.

W. A. HADLEY[1], New York, N. Y. (WRITTEN): The authors are to be congratulated on their paper which presents some very interesting analytical data and the Lord Kelvin line sink theory, in a more easily used form for ground coils than has hitherto been available. The Heat Pump Committee of the *Edison Electric Institute* has had several occasions to use line sink theory

[1]Assistant professor of mechanical engineering, Columbia University.

calculations and up until now they have been quite laborious.

In connection with this work it is the writer's experience that line sink theory predictions do not correlate in the majority of cases with actual test results. Five experimental installations were studied by the writer and the percent deviations of the temperature differences were as follows: +51, +82 with unfrozen soils and —11, +101, +206 with frozen soils. Consideration of these findings would indicate that in special cases the line sink theory calculations may be useful but in general they should be used with caution.

It is interesting to note that in all but one case the temperature difference predicted by line sink theory was significantly larger than the temperature difference actually required. This would mean that ground coils sized by line sink theory would be correspondingly oversize.

The reasons for the above discrepancies have not been adequately explored. Professor Coogan[2] indicates that it is associated with the frozen soil. There is also evidence[3] indicating that it is associated with the moisture in the soil and its movement.

The authors state that they considered such factors as thermal migration, and convection of liquid water and diffusion of water vapor in sufficient degree to indicate that simple conduction is the dominant factor in heat transfer in soils. It would be very valuable if the authors would give the details of the studies they made in arriving at this conclusion as there is little information available on this subject in the literature at this time.

C. F. KAYAN, New York, N. Y. (WRITTEN): The authors, in making their most welcome contribution, do well to advocate caution in regard to the general possibility of using the earth as a *reverse cycle* heat source. This is most important lest uninformed enthusiasts rush in with ground coil installations, where climatic conditions are severe and heating requirements predominate, only to achieve discouraging and discrediting failure. Direct heat sources such as air offer a more reliable basis for safe prediction of performance.

Aside from the obvious mathematical difficulties due to non-uniformity of physical properties of earth and due to the variation in initial temperature conditions in the region affected by the heat absorbing surface, the applicability of some of the available mathematically derived equations to this present specific problem must continue to be scrutinized critically. For example, would it be reasonable to assume that a vertical equivalent flat plate one foot wide, installed vertically to an extent of 5,000 ft, would behave the same as an equivalent vertical flat plate 50 ft high and 100 ft wide, or as another one 10 ft high and 500 ft long? And should the performance of the one-foot wide plate be closer to that of the separate pipes, such as the 3.82 in. tube, than as at present indicated?

It is reasonable to assume that a grid of small closely spaced pipes will act in effect as a continuous receiving plate. Verification for this is indicated by electric Analogger[4] panel heat flow studies by the writer. It was found that with imbedded pipes under steady state conditions and with decreasing heat flux densities, the panel tends to reach uniform surface temperature conditions.

J. H. CARTER, St. Louis, Mo., referred to the problem of storing heat in summer for the purpose of heating a residence in winter. He stated that a reservoir of water buried in the earth and allowed to freeze in winter by the extraction of heat, would require a volume just about equal to the volume of the house. This was an indication of the impracticability of storing summer heat in water for winter residence heating purpose.

E. W. GUERNSEY commented on the various discussions. He pointed out that while the study was limited to conditions outlined in the paper, the authors were nevertheless aware of the complications caused in ground coil calculations by sources of heat other than that obtained by conduction from the earth. Prominent among such other sources would be heat from ground water streams and the heat obtained from the sun by absorption at the surface. Dr. Guernsey's closure will appear with the paper when published in the 1949 ASHVE TRANSACTIONS.

Travelling to Minneapolis by plane *(L. to R.)* P. B. Gordon, Mr. and Mrs. L. B. Belford, pilot, and Mrs. A. J. Nesbitt

Chairman Avery announced that a cable had been received from the Institution of Heating and Ventilating Engineers:

> COUNCIL OF *IHVE* SEND GREETINGS AND GOOD WISHES FROM SUMMER MEETING AT EASTBOURNE — H. H. BRUCE, PRESIDENT *IHVE*

This cable, as well as the announcement of Mr. Avery that a message would be sent to *IHVE* was received with pleasure by the members.

Chairman Avery asked Edward G. Spall of the Ontario Chapter, to make an announcement regarding the next Semi-Annual Meeting of the Society. Mr. Spall stated that the ASHVE Council had accepted the invitation of the Ontario Chapter, and that the 1950 Semi-Annual Meeting would be held at the Royal Muskoka Hotel on the Muskoka Lakes in Canada.

[2]Heat Transfer Rates by C. H. Coogan. (*Mechanical Engineering*, Vol. 71, No. 6, June 1949.)

[3]The Effect of Soil Moisture on Buried Receivers for Heat Pumps by W. A. Hadley. (*Electrical Engineering Bulletin*, Vol. 17, No. 1, January 1949.)

[4]Heat Transfer and Temperature Distribution in a Panel With Imbedded Pipe, by C. F. Kayan. (*Refrigerating Engineering*, August 1947.)

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J. DONALD KROEKER, consulting engineer, Portland, Ore., then presented the paper, **Heat Pump Results in Equitable Building**, which he prepared with R. C. Chewning and C. E. Graham, as co-authors, and which was a review of the results obtained in the operation of the heat pump installation in the Equitable Building, Portland, Ore. (published in July 1949 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

E. P. PALMATIER, Syracuse, N. Y., presented a written discussion, commenting on the paper. He stated that the Equitable Building was a fine example of the application of good engineering to the over-all heat balance of an office building wherein the greatest economy was achieved by eliminating the use of fuel-burning equipment for heating. He also inquired about the origin of the term *diffusion-type centrifugal water chilling machines*, and requested that the authors clarify certain points regarding the information given in Figs. 7 and 8, and Table 3.

DR. GUERNSEY, Baltimore, Md., pointed out that the availability of a well water supply from wells at different temperatures presented an advantage which was quite exceptional. He also mentioned that the term *coefficient of performance* when referring to the values shown in Table 4, perhaps should not properly be called coefficient of performance. He mentioned that the term *coefficient of performance* as used in Table 4 was not consistent with the usual meaning of the term which is generally considered as an index of effectiveness of a given motor-compressor combination in moving heat from a lower to a higher level.

G. E. MAY, New Orleans, La., in a written discussion which had been forwarded to the meeting, pointed out that availability of 1100 Btu natural gas in the middle South section of the United States had made it more economical to operate air conditioning systems with natural gas than to operate by means of heat pump installations using electricity as a motive power, even though many sources of high temperature water were available during the winter months. He also stated that in the middle South area the air-to-air model heat pump units had failed to perform satisfactorily, even in small commercial applications when the outside temperature dropped below 45 F. On the other hand, water-to-air units seem to work very satisfactorily using water at 68 to 72 F from wells drilled to a depth of 800 ft.

MR. KROEKER, in his closure, agreed that the availability of well water was a special advantage in the case of the Equitable Building, and that in any installation contemplated it would be necessary to first determine the availability of heat sources. An investigation of the temperature and quantity of water available should be made as a preliminary to the design of any installation. The complete discussions and the author's closure will appear with the paper in the 1949 ASHVE TRANSACTIONS.

Effects of Weather on Ground Temperatures

J. V. BORRY, Minneapolis, Minn., presented the paper, **Ground Temperatures as Affected by Weather Conditions**, by A. B. Algren, as Professor Algren was unavoidably absent because of illness (published in June 1949 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

MR. KROEKER referred to the value of the paper in indicating the march of temperature at various depths. Such information, he stated, would require standardization in methods of testing and other details, particularly in regard to the classification of soil. He pointed out that in some localities it had been found by experience that ground coils should not be located at the depth obtaining the highest ground temperature, because temperature recovery of the soil at this level was sometimes too slow. In Oregon where average winter temperature is about 49 F, and where the average well water temperature at steady state levels is about 55 F, a depth of four feet below the surface seems to be most favorable for heat pump coils.

In a written discussion prepared by R. S. Dill, Washington, D. C., presented by P. R. Achenbach, he believed that the three-week temperature lag of the ground at one-foot depth was longer than would have been obtained if temperature readings had been taken more frequently. Earth temperatures at one-foot level had been found to follow the air temperature within a couple of days when the temperatures were read once per day or more often. He pointed out that earth temperature at a particular point and time is affected by the average air temperature preceding the time of observation. A quick air temperature drop might not have as much influence as a longer period of moderate cold. Consequently, earth temperatures might possibly be correlated with degree days rather than air temperature. Mr. Dill felt that attention to the influence of sod or vegetable covering was justified. The depth of snow would also affect the ground temperature, but no mention of snow depth had been made in the paper. It was recommended that the author consider the effect of latent heat of water present in the earth, since this latent heat would be a source which would delay temperature drop until the water had been frozen to the depth at which observation was being made. The presence of this moisture might account for some of the temperature changes.

E. P. PALMATIER, Syracuse, N. Y., inquired whether the marked dip in temperature indicated from 16 ft up to

Members relaxing between technical sessions

about 9 ft depth about September 20, was correlated with any of the known factors affecting these temperatures.

In giving the author's closure, Mr. Borry stated that final comment by Professor Algren would be included with the paper when published in the 1949 ASHVE TRANSACTIONS. He mentioned that the effect of snow under sunlight conditions was to cause less absorption of heat (because of reflection of sun's rays) than would be obtained by uncovered ground. The effect of the snow in insulating the ground and reducing heat loss was to some extent counteracted by the decreased heat absorption from the sun obtained when the ground was covered with snow.

The technical session was adjourned at 12 noon.

Measurement of Moisture Travel Through Materials

Third Technical Session, June 22, 9:30 a.m.

L. E. SEELEY, second vice-president, called the third technical session to order at 9:30 a.m., and introduced E. R. Queer, Professor of Engineering Research, The Pennsylvania State College, State College, Pa., who presented his paper, **Permeance Measurement Improved by Special Cell**, with F. A. Joy as co-author (published in June 1949 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

A. E. STACEY, JR., president, expressed a keen interest in the research work which had resulted in the preparation of this paper, and stated that the equipment would be very useful in obtaining needed information on the travel of moisture through building materials. He also asked about the effect of velocity of vapor over the test specimen upon the transfer of moisture.

In a communication received from R. S. DILL, Washington, D. C., it was pointed out that the equipment developed by the authors would have a very practical use in obtaining information on the condensation problem in buildings. Mr. Dill pointed out the importance of differentiating between the resistance of any barrier to vapor transmission, and the resistance obtained by such a barrier when installed in building construction. The effectiveness of a vapor barrier may be greatly reduced because of damage caused by workmen installing various services in buildings, such as plumbing and electrical wiring.

In a discussion submitted by F. T. CARSON, Washington, D. C., he emphasized the difficulty of selecting new words such as *permeance* and *perm* without having conflicts with the same terms used as units in other fields.

D. D. WILE, Los Angeles, Calif., in a discussion which was presented by Arthur Hess, Los Angeles, complimented the authors on the experimental technique developed. He inquired whether any difficulty had been experienced in maintaining a seal between the test specimen and the ring in which it was held. He also inquired whether the electric hygrometer sensing elements had been checked for accuracy under conditions of use.

F. M. GAVAN and S. W. EBY of Lancaster, Pa., reported that in tests conducted using the *ASTM* method of determining moisture transfer and comparing it with the results obtained by use of the new cell developed by the authors, it had been found that the latter, in some cases, produced as much as three times the rate of moisture transfer obtained in the former. From tests conducted it was also concluded that results could be duplicated more easily by using the cell described by the authors than by using the *ASTM* cup method.

F. B. ROWLEY, Minneapolis, Minn., pointed out that his discussion referred to the rating of vapor barriers after testing rather than to the equipment described by the authors. He pointed out that the transfer of vapor through materials is affected by several factors such as surface resistance, internal resistance, temperature of the material, state of the moisture in passing through the material, and the hygroscopic properties of the materials. Professor Rowley mentioned that for non-hygroscopic materials whose temperature at all points is above the dew-point temperature of the vapor, the rate of vapor transfer may be assumed to be directly proportional to the vapor pressure difference on the two sides of the material, and inversely proportional to the vapor resistance of the material. If some vapor is absorbed by hygroscopic material, or if the temperature at any point is below the dew-point, the rate of moisture transmission will not be proportional to the vapor pressure difference.

H. E. ZIEL, Detroit, Mich., inquired whether equipment could be used for measuring the water vapor flow through slots from a low dew-point area to a high dew-point area under conditions of still and moving air.

LESTER T. AVERY, Cleveland, Ohio, inquired whether the equipment described could be used to determine the water holding content of various building wall structures.

The author's closure as presented by Professor Joy will be published with the paper in the 1949 ASHVE TRANSACTIONS.

Human Heat Tolerance

CRAIG L. TAYLOR, associate professor, Engineering Department, University of California, Los Angeles, Calif., presented the paper, **Human Tolerance Limits for Extreme Heat**, which he prepared with W. V. Blockley (published in May 1949 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

Comments by C.-E. A. Winslow, L. P. Herrington, New Haven, Conn.; Lt.-Col. A. P. Gagge, Dayton, Ohio, and E. F. Du Bois, M.D., New York, N. Y., were read.

DR. WINSLOW pointed out the very high correlation obtained for mean skin temperature and heart rate with air temperature. It was also noted in Fig. 2 that at 140 F, and to a less extent at 160 F, the index for physiological strain plotted against time levelled off for the first half hour, due perhaps, to increased evaporative efficiency. It was a striking observation that after exposure to about 240 F air temperature for 24 min, the rectal temperature should have reached 100.8 F, the mean skin temperature 105 F, and the heart rate 150 beats. The tolerance time would have been further decreased by a high humidity.

MR. HERRINGTON stated that the authors had produced the first systematic data on short-term human heat tolerance. While the strenuous nature of human experience required in such tests would make it difficult to extend the data, it was nevertheless suggested that the effect of high vapor content at

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Minneapolis hospitality in the open air

these elevated temperature conditions was of such importance that it should be investigated. Mr. Herrington cautioned users of results such as published in this paper, that there is a vast difference between the tolerance time here determined and the permissible recurrent exposure time. Even for occasional exposure, limits for exposure could only be some percentage of the exposure periods used in these tests.

COLONEL GAGGE expressed the thought that tests of the type reported by the authors and others might result in more complete definitions of tolerance based on both physiological and psychological factors. He considered that the work of the authors had overcome major problems of equipment and technique, and that hereafter it was to be hoped that their results could be made generally applicable to industrial and military problems.

DR. DU BOIS stated that this was a valuable study of short exposure, and remarked that experimentation was difficult because of the danger to subjects and the difficulty of obtaining more volunteers. He felt that wide variations and some cases of low tolerance might be expected if tests on a larger number of subjects were conducted. He pointed out that impairment of efficiency in dry and humid heat is a limiting factor in airplanes and submarines.

C. M. HUMPHREYS, Cleveland, Ohio, inquired whether any acclimatization to high temperature had been given to any of the subjects before subjecting them to tests. In work done for the U. S. Navy he had found that the degree of acclimatization acquired had a marked effect upon the ability of the subjects to endure the conditions imposed. Also, in the Navy studies the object was to determine the most severe conditions under which the average man could remain alert and active throughout a four-hour watch. The subjects were therefore active and not seated at rest, and consequently limiting values for pulse rate and temperature were lower. Mr. Humphreys referred to the excellent correlation obtained by the authors on the basis of effective temperature with the work of McConnell, Houghten and Yaglou at the ASHVE Laboratory. Fig. 3 of the paper shows this correlation between air temperatures of approximately 180 to 240 F, or 106 to 114 deg ET. Additional data from the ASHVE tests would permit extension of the smooth curve of Fig. 3 up to a dry bulb temperature of 143 F or 98.2 ET, and an exposure time of almost three hours.

The author's closure will appear with the paper in the 1949 ASHVE TRANSACTIONS.

N. R. GAY, associate professor of Heat-Power Engineering, Cornell University, Ithaca, N. Y., presented the paper which he and C. O. Mackey prepared, **Heat Gains Are Not Cooling Loads** (paper and discussion published in this issue, see p. 105).

The final paper of the session was, **Solar Energy Transmittance of Eight-Inch Hollow Glass Block**, by George V. Parmelee and Warren W. Aubele, and was summarized by Mr. Parmelee, research fellow, ASHVE Research Laboratory, Cleveland, Ohio (to be published with discussion in September 1949 JOURNAL SECTION, *Heating, Piping & Air Conditioning*).

Dean Seeley then turned the meeting over to President Stacey who announced the final registration for the meeting as follows: members 242; ladies and children 120; guests 42; a total of 404.

Resolutions*

WHEREAS the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS has just concluded its 1949 Semi-Annual Meeting in Minneapolis; and

WHEREAS it is fitting and proper that the membership of this Society express its appreciation to all of those organizations and individuals who have contributed to make this meeting an outstanding success in every way; and

WHEREAS the Minnesota Chapter, through its President, Richard C. Jordan, and through its other officers and its members, and especially through its Committee on Arrangements headed by John E. Haines as General Chairman, have so well organized and executed their responsibilities as hosts; and

* * *

WHEREAS this meeting has been made significant by the scientific contributions of the authors and discussers at the technical sessions; and

WHEREAS the Chapter ladies have so graciously and charmingly made this sojourn one long to be remembered by the visiting members and their families; and

WHEREAS this entire meeting has been suffused with the glow of hospitality and fellowship, and has been invigorated by the salubrious climate of this most pleasant and genial setting, including, with the charm of a delightful countryside, the amenities and cultural refinements of a great metropolitan center; and

* * *

WHEREAS the comfort and well-being of our visiting members and their families have been greatly enhanced through the capable efforts of the hotel managements and staffs; and

WHEREAS all of the visitors have enjoyed and profited by the cultural advantages of this setting:

NOW, THEREFORE, BE IT RESOLVED THAT the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS hereby expresses its sincere appreciation to the Minnesota Chapter, to the authors of papers, to the technical committees, to the Convention Bureau of Minneapolis, to Station KSTP, to the local plants opened for inspection; to the newspapers and trade press for their attendance and splendid coverage of our sessions; and to all of the organizations and individuals enumerated; and

THAT this resolution be spread upon the minutes of this meeting, and the secretary of the Society be instructed to transmit a copy thereof to the president of the Minnesota Chapter.

Respectfully submitted.
RESOLUTIONS COMMITTEE
Carl F. Kayan, *Chairman*
Thomas D. Stafford
John Hayes Carter

President Stacey expressed the appreciation of the Officers, Council and members to the Minnesota Chapter whose hospitality and labor had made the Semi-Annual Meeting 1949 a great success.

As there was no further business, President Stacey declared that the Semi-Annual Meeting 1949 was adjourned.

*Adopted June 22, 1949 by Semi-Annual Meeting, ASHVE.

Entertainment in Minneapolis Follows Informal Summer Style

Hospitality Plus

Informal pastimes and good fellowship were keynotes of the entertainment portion of the ASHVE Semi-Annual Meeting in Minneapolis, June 20-22, 1949. In the Hospitality Room of the Nicollet Hotel, at the Monday night Smorgasbord party, and at the banquet which topped the three-day program, the accent was on relaxation, summer style.

Parlor JK was the Hospitality Room, where from Sunday to Wednesday, Minneapolis Chapter members and their wives played the gracious host to all who dropped in. Until midnight on each night of the three days, ASHVE members and guests found the Hospitality Room a genial place, with an informal program of movies, refreshments and pleasant conversation.

Fruit Soup and Long Hair

The Smorgasbord dinner on Monday night was prefaced by a social hour during which accordionist Kathy Kohls entertained with several selections. Long wigs were distributed to those present, and with two amateur barbers in attendance, the wig-wearers had haircuts to suit their individual whims. There was a great deal of activity during this hour as camera owners gleefully snapped pictures of dignified engineers "with their hair down."

The dinner for the 344 persons present was conducted in the Swedish tradition, with an assortment of cold meats, relishes, salads, roast beef, fish, Swedish fruit soup, etc. on the groaning board from which each guest helped himself according to his tastes.

A male beauty contest was staged following dinner, with each table group selecting one participant. The contestants were allowed to use only available material with which to make themselves as "attractive" as possible. This was accomplished by means of liberal applications of table decorations —leaves, flowers, napkins, etc. The contest was won by M. M. Stevens, a guest, who was selected by three judges: Mrs. Alfred E. Stacey, Jr., Mrs. Ernest Szekely and Miss Dorothy M. Mildner.

When the hilarity caused by the beauty contest had dwindled, the Smorgasbord Quartet composed of H. R. Nichols, V. Dale Wissmiller, J. E. Haines, and J. S. Locke stepped in to fill the breach. The quartet was just as good as the voices heard from the phonograph record playing in the background—no better, no worse. But so well done was the pantomime that a casual listener would not have noticed whose voices were doing the singing.

Music for the dancing that followed was furnished by Ted Johnson's orchestra.

Banquet Without Speakers

In the same light-hearted summer vein as the preceding entertainment, the Wednesday night banquet on June 22 had no scheduled speakers. But there was a speakers' table, presided over by Bob De Haven, CBS broadcaster in Minneapolis. Guests sitting at the speakers' table included: Mr. & Mrs. Alfred E. Stacey, Jr., Lester T. Avery, Dean L. E. Seeley, Mr. & Mrs. Ernest Szekely, Prof. & Mrs. F. B. Rowley, Prof. & Mrs. R. C. Jordan, Mr. & Mrs. L. C. Gross, and Mr. & Mrs. John E. Haines.

Mr. De Haven, acting as master of ceremonies, conducted a make-believe radio program with audience participation. A microphone was taken to tables and persons who had birthdays on June 22 were chosen for interviews. Among the puzzling questions asked of the lady participants was: *What Makes a Good Husband?* Answers to this question were amusing as well as divided.

Golf Trophies Awarded

Three golf trophies were awarded during the course of the banquet. These were The Research Cup, the Eichberg Memorial Cup and a special trophy called the Paul Bunyan Cup. A team composed of Minneapolis chapter members won the Eichberg Cup which was presented by Past President M. F. Blankin. The Research Cup, presented by John James, was won by R. H. Lee. The Paul Bunyan trophy, designed and contributed by Bruce McLouth, was presented by Bob De Haven to W. H. Old, Detroit, for being the most honest golfer with the highest score. This cup, which is of stainless steel, will be retained by Mr. Old for one year. It made up in size and bulk for what it lacked in artistic design, and was awarded with the idea of a permanent trophy—to be awarded each year during the Semi-Annual Meeting.

So far on this occasion, things had gone along quite informally. At this point, however, the audience was given a scare when after no speeches had been stressed an unknown individual arrived, insisting upon making a speech. Displaying the proper credentials, this unidentified individual was finally allowed to speak.

The speech turned out to be an agreeable surprise, and the "speaker" was revealed as humorist Hal Olson, whose jokes and anecdotes provided a pleasant touch to the last hours of the three day meeting.

Members and guests treating themselves Smorgasbord style

Honored by Life Membership

Walter E. Barnes
Boston, Mass.

WALTER E. BARNES

—President of Barnes & Jones, Inc., Boston, Mass. since 1930; partner from 1921 to 1930.

—President-Treasurer of Thermograde Valve Co., Boston, 1902-1921.

—Graduated Lowell School under auspices of M.I.T., Cambridge, 1905.

—A former member of *American Society of Mechanical Engineers, American Society of Civil Engineers,* Engineers Club of New York City, Engineers Club of Boston.

—Began career in 1894 as draftsman for heating & ventilating systems; later engineer and supervisor in engineering, sales and management.

ARTHUR F. BOWERS

—President of the Industrial Heating & Engineering Co., Milwaukee, Wis.

—Affiliated with Industrial Heating & Engineering Co., since 1909.

—Member of *Heating, Piping & Air Conditioning Contractors National Association;* secretary of Wisconsin section since 1926; past president of Milwaukee section.

—Born Akron, Ohio, 1879; lives in Milwaukee, Wis.

Arthur F. Bowers
Milwaukee, Wis.

Peter D. Butler
Cliffside Park, N. J.

PETER D. BUTLER

—With U. S. Radiator Corp., Detroit, Mich. as sales representative from 1921 until his retirement in 1945.

—In charge of heating department of Werner Bros., Jersey City, N. J. from 1908 to 1921.

—Installed heating systems and related branches throughout New England and eastern states for some years after 1898.

—Began career at the age of 18 as apprentice in the heating field with Clapham and Butler, South Norwalk, Conn.

—Born in New York State; lives in Cliffside Park, N. J.

BERTRAM C. CANDEE

—Partner with Beman & Candee, consulting engineers, Buffalo, in heating, ventilating, air conditioning, plumbing and electrical work.

—Licensed Professional Engineer in New York State 1922; machine designer and superintendent of manufacturing plants for several years.

—Mechanical engineer since 1894; one year's practice as architect.

—Educated in Dunkirk, N. Y. schools and Cornell University, Ithaca.

—Treasurer of Western New York Chapter 1935, president 1937-38, and treasurer since 1938.

Bertram C. Candee
Buffalo, N. Y.

Robert B. Dickson
Kewanee, Ill.

ROBERT B. DICKSON

—President, Kewanee Boiler Corp., Kewanee, Ill. since 1930.

—Began in 1905 with Kewanee Boiler Corp., in accounting department. Later transferred to sales department: branch manager, general sales manager to 1930.

—Earlier experience: Hayes Pump and Planter Co., Galva, Ill. 1899 to 1904.

—Born 1883 in Streator, Ill.

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Honored by Life Membership

THOMAS M. DUGAN

—Sanitary and heating engineer, McKeesport, Pa.

—Has represented ASHVE on several committees of the *American Standards Association* in connection with piping.

—Member of Pittsburgh Chapter ASHVE; President 1926-27. Has supplied material on piping for THE GUIDE of the Society. Has attended 24 Annual and seven Semi-Annual Meetings.

—Now national executive secretary and librarian for the *American Society of Sanitary Engineering* at McKeesport.

—Formerly sanitary-heating engr., The National Tube Co., McKeesport.

Thomas M. Dugan
McKeesport, Pa.

EDWIN ELLIOT

Edwin Elliot
Philadelphia, Pa.

—Head of Edwin Elliot and Co., sales engineers, Philadelphia, Pa.

—Formerly superintendent of foundries for Midvale Steel Co., and assistant to chief engineer of Commercial Museum, Philadelphia.

—Graduate of University of Pennsylvania, Philadelphia.

—Past President of Engineers Club of Philadelphia; past president of Philadelphia Chapter ASHVE, Philadelphia section *National Association of Power Engineers.*

—Member *Pennsylvania Society of Professional Engineers;* member Franklin Institute.

MICHAEL J. GIBBONS

—Owner and Partner, M. J. Gibbons Supply Co., Dayton, Ohio, since 1919.

—Before 1919, associated with M. J. Gibbons Engineers and Contractors as engineer and manager in charge of designing of heating, plumbing, water supply and electric lighting plants.

—Attended Georgetown University, Washington, D. C., and Massachusetts Institute of Technology, Cambridge, Mass.

—Member *American Society of Mechanical Engineers,* Engineers Club of Dayton, *Professional Engineers Society of Ohio.*

Michael J. Gibbons
Dayton, Ohio

ALBERT B. MARTIN

Albert B. Martin
Chicago, Ill.

—With Kewanee Boiler Corporation since 1914—Chicago Branch Manager for the past 28 years.

—With Lewis & Kitchen and S. R. Lewis of Chicago from 1903.

—Past President of the Illinois Chapter ASHVE.

—Veteran member of the Rotary Club of Chicago—Heating Boiler Mfg. classification.

EDMUND P. HECKEL

—Consulting engineer in Chicago, Ill. for heating, ventilating, air conditioning and refrigeration.

—One of the seven original founders of the Carrier Engineering Corp., organized in 1915 (now Carrier Corp., Syracuse, N. Y.).

—For 20 years, vice pres. and western mgr. of Carrier Engineering Corp.

—Served as member of TAC's of ASHVE, Guide Publication Committee, Finance Committee, Admission and Advancement Committee. A past president of Illinois Chapter.

—Member of *ASRE* and *Chicago Association of Consulting Engineers.*

Edmund P. Heckel
Chicago, Ill.

Honored by Life Membership

Lee P. Hynes
Camden, N. J.

LEE P. HYNES

—Consultant, Camden, N. J. in electrical and mechanical engineering, specializing in electric heating, industrial process design, pressure vessels, explosion-proof equipment and ice melting at hydro electric dams.

—Has taken out more than 125 U. S. and foreign patents.

—In 1930 organized the Hynes Electric Heating Co., Camden, N. J.

—Fellow, *ASME;* Fellow, *AIEE;* Member, *National Society of Professional Engineers;* past president, Engineers Club of Philadelphia.

—Studied mechanical engineering at University of Michigan, Ann Arbor.

MARSHALL S. JACKSON

Marshall S. Jackson
Buffalo, N. Y.

—Manufacturers representative, Buffalo, N. Y. since 1919.

—In 1905 entered office of the Powers Regulator Co., Chicago, later in charge of installations of automatic temperature control equipment.

—Supervised operations for the Powers Regulator Co. in Seattle, Wash. and also in Vancouver area.

—Studied mechanical engineering at University of Minnesota.

—One of group who organized Western New York Chapter of ASHVE. Past president (1927-8).

Charles W. Stewart
Boston, Mass.

CHARLES W. STEWART

—Now with Emerson-Swan, Inc., Boston, Mass. sales and engineering.

—Vice President in charge of sales, Clark Manufacturing Co., Cleveland.

—19 years with the Hoffman Specialty Co., Indianapolis, as zone manager, assistant general sales manager and vice president in charge of sales.

—Began career with American Radiator Co. in 1906—sales department and also planning heating installations.

—Draftsman, sales engineer, Haynes Selling Co., Philadelphia, 1917-21; president, 1922-26.

HOMER A. THRUSH

Homer A. Thrush
Peru, Ind.

—President, H. A. Thrush & Co., Peru, Ind.

—Began engineering experience in 1903 in a central heating plant having 1¾ miles of mains and 200,000 sq ft of radiation.

—Experience includes, estimating, designing heating plants, testing boiler and fuel efficiency, and supervising construction.

Arthur G. Sutcliffe
Chicago, Ill.

ARTHUR G. SUTCLIFFE

—Until retirement in 1947, chief engineer with Ilg Electric Ventilating Co., Chicago.

—Earlier was employed by Commonwealth Edison Co., Chicago, on power plant and substation construction.

—Worked on development of some of the first commercial electric welding machines at Warren Electric Co., Sandusky, Ohio.

—Training course at Western Electric Co., Chicago, in power apparatus section; student at Lewis Institute, Chicago and Cooper Union, New York.

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WALTER TUSCH

—Retired in 1944 after 43 years with Tenny & Ohmes, Inc., New York, N. Y., secretary of the corporation 1936-44.

—Had charge of heating and ventilating design for Statler Hotel, Savoy Plaza Hotel, American Museum of Natural History, and Stock Exchange in New York City, and Statler Hotels in Buffalo and Boston.

—Began career in 1901, with Alfred R. Wolff, pioneer consulting engineer in U. S. for heating and ventilating design.

—Licensed Professional Engineer—1928.

Walter Tusch
New York, N. Y.

Louis S. Vance
Baltimore, Md.

LOUIS S. VANCE

—Manufacturers Agent since 1915, now in Baltimore, Md., representing companies in design and sales of heating and ventilating equipment.

—Experience with U. S. Housing Corp., Washington, D. C., Spencer Heater Co., Philadelphia, Pa., American Radiator Co., and Crane Co., Chicago, Ill.

—Attended Armour and Lewis Institutes, Chicago.

—Member *Air Conditioning, Heating and Ventilating Engineers of Baltimore; American Society of Naval Engineers,* Washington.

ENGINEERING SOCIETIES HOLD SUMMER MEETINGS

AIEE

A paper, Electrode Type Steam Boilers and Water Heaters, by S. A. Williams, was among many presented at the 1949 summer general meeting of the *American Institute of Electrical Engineers* in Swampscott, Mass., from June 20 to 24.

Other technical presentations included papers on electric welding, instruments, electric heating and applied mathematics, infra-red radiation, and engineering education.

J. F. Fairman was elected president for the year beginning August 1, 1949, and the vice presidents elected are as follows: C. G. Veinott, Lima, Ohio; W. J. Seeley, Durham, N. C.; W. C. DuVall, Boulder, Colo.; R. A. Hopkins, Los Angeles, Calif.; and A. H. Frampton, St. Catherines, Ont., Canada.

ASME

Atomic energy for industrial use was one of the topics discussed at the Semi-Annual Meeting of the *American Society of Mechanical Engineers* held on the University of California campus at San Francisco, June 27 to July 1, 1949.

Synthetic fuels, steam power, and industrial instruments were other topics presented during the technical sessions.

ASTM

The *American Society for Testing Materials* held its 52nd Annual Meeting in Atlantic City, N. J., during the week of June 27, 1949.

A number of reports were given on metals, plastics, insulating materials, concrete, and other substances. Throughout the five days, many of the *ASTM* technical committees were in session, working on specifications, tests and standardization.

SMA

French Lick, Ind., was the gathering place for members of the Stoker Manufacturers Association, which held its Annual Meeting June 13 and 14, 1949.

An annual technical conference, a business session, and panel discussions were parts of the agenda, with the annual banquet completing the program on the evening of June 14.

DILUTION OF WASTE STACK GASES IN THE ATMOSPHERE*

Using a constant concentration of oil-fog forced up a 200-ft stack, the results of 36,000 samples of diluted oil-fog taken near the ground during unstable conditions and 4000 samples taken in the air during stable conditions are given with respect to types of mixing and amount of dilution under these two major atmospheric conditions.

When the air is thermally unstable, the stack gas plume will alternately descend to the ground and then ascend within the unstable layer. Dilution is rapid per unit distance downwind because of mixing by eddies, but the plume may intersect the ground virtually at the base of the stack only little diluted from its stack concentration. When the air is stable, the plume remains embedded in a thin horizontal layer widening and dilutes slowly downwind. Values of dilution when the atmosphere is in neutral stability are intermediates between those of the stable and unstable condition.

*Paper presented by P. E. Church, University of Washington, before the 115th meeting of the *American Chemical Society* at San Francisco, California, March 27, April 1, 1949.

Summary of Chapter Meetings*

NORTH CAROLINA STUDENTS HONOR PROFESSOR VAUGHAN

A SPECIAL banquet meeting was held May 6, 1949 in Raleigh, N. C., by 50 members and guests of the North Carolina State College Student Branch to honor Prof. L. L. Vaughan, who retired July 1 after 41 years of service on the State College faculty.

The guests included Professors W. S. Bridges, T. C. Brown and F. B. Wheeler, who have been colleagues of Professor Vaughan for many years. Toastmaster for the occasion was John G. Marshall, 1948-9 President of the N. C. Student Branch.

In a presentation speech, Philip S. J. Moore, Jr. expressed the students' appreciation for the many services which Professor Vaughan has performed for the members both individually and collectively. It was pointed out that Professor Vaughan was instrumental in organizing the State College Student Branch, and has since acted as the Branch faculty adviser. Mr. Moore then presented Professor Vaughan with a leather traveling case on behalf of the Student Branch.

Prof. L. L. Vaughan

Professor Vaughan replied with a brief expression of his thanks. Retiring president Marshall then introduced the new president of the Student Branch, J. J. Andrews. Also introduced were the other new officers of the N. C. State College Student Branch: Vice-President, J. W. Westbrook; Secretary, E. A. Stroupe; Treasurer, W. L. Glasgow; and reporter, B. H. Cathey.

PROFESSOR VAUGHAN HAS DISTINGUISHED RECORD

During his tenure at North Carolina State College, Raleigh, N. C., Professor Vaughan was at first an instructor and later became head of the mechanical engineering department. From 1942 to 1945, he was acting dean of the school of engineering, and in July 1947, he resigned as head of the mechanical engineering department to become director of instruction for the school of engineering.

Most of his professional work has been in the field of heat and power. Specializing in heating and ventilating, he is largely responsible for the plan and general arrangement of the State College power plant and heating system.

In 1947, Professor Vaughan was honored by the North Carolina Society of Engineers, who bestowed on him the annual award for "outstanding engineering achievement."

Besides belonging to the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Professor Vaughan is a member of the *American Society of Mechanical Engineers*, Society for the Promotion of Engineering Education, North Carolina Society of Engineers, and Raleigh Engineers Club. He is a past chairman of the Raleigh Section of the *ASME*.

He is listed in Who's Who in Engineering, American Men of Science and Who's Who in American Education.

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

• CONNECTICUT—June 28, 1949. The meeting was an outing which took place at Racebrook Country Club, New Haven. Business was dispensed with, as members participated in golf. Following the games, dinner was served, and golf awards were made. A general discussion concluded the meeting. Attendance 38. Attendance ratio 0.34.

• DELTA—May 10, 1949. During the regular dinner meeting in New Orleans, new officers for the year of 1949-50 were elected as follows: *President*—R. B. Guest; *Vice President*—Ralph Elizardi; *Treasurer*—Fritz Gutknecht; *Secretary*—Theodore Offner; *Board of Governors*—H. L. Salaun and A. R. Salzer, Jr.

Three speakers, who were members or guests, gave talks on interesting and unusual local applications of heating, ventilating and air conditioning. C. V. Bankston spoke on a tomato ripening project; W. A. Lagrange described a cold storage and freezing plant for seafood; Walter Taylor described a skating rink.

Retiring Pres. L. V. Busenlener was presented with a pen and pencil set as a token of appreciation from the chapter. Presentation was made by incoming president R. B. Guest. A past president's certificate was given to Walter H. Grant, Jr., who was absent from the 1948 annual meeting of the chapter, at which time other past presidents were so honored.

A report was given by entertainment committee chairman T. A. Stokes regarding a joint meeting to be held in July with the *ASRE*. Other reports were given by J. S. Adair and Mr. Grant. Attendance 21. Attendance ratio 0.34.

• ILLINOIS—May 9, 1949. The meeting was a social gathering held

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in Chicago. Results of the election of officers for the coming year were announced as follows: *President*—J. S. Kearney; *Vice President*—P. J. Marschall; *Secretary*—G. W. Bornquist; *Treasurer*—H. G. Chapin; *Board of Governors*—M. W. Bishop, M. J. Bamond, G. V. Zintel, C. M. Burnam, Jr.

Guest speaker was ASHVE President, Alfred E. Stacey, Jr., who spoke about his former membership in the Illinois chapter and also outlined the work of the Society. President Stacey made the presentation of the Life Membership certificate to A. G. Sutcliffe.

The new president of the chapter, Mr. Kearney, was introduced and then presented a past president's pin to Mr. Burnam. It was announced that the *Western Trade Golf Association* has designated August 16 as "ASHVE day" at the Midlothian Country Club.

Entertainment was in charge of Don Dowd, radio announcer. Attendance 114. Attendance ratio 0.24.

• INDIANA—May 27, 1949. At the May meeting in Indianapolis, election of new officers was held, with the following results: *President*—W. R. Fenstermaker; *Vice President*—C. F. A. Locke; *Secretary*—F. C. Barton; *Treasurer*—F. A. Stickle; *Board of Governors*—W. E. Goohs, C. H. Hagedon, P. R. Jordan.

Speakers were Riley Shuttleworth and S. E. Fenstermaker, Jr., who reported their experience with panel heating and baseboard radiation on a large number of installations made during the year. Practical rather than theoretical problems were emphasized.

Reports were given by the treasurer and the secretary and by J. G. Hayes. Attendance 65.

• MASSACHUSETTS—May 17, 1949. At the dinner meeting in the MIT Graduate House, Cambridge, newly elected officers for the coming 1949-50 season were installed as follows: *President*—W. H. Shipp; *Vice President*—D. W. Blair; *Secretary*—J. P. Licandro; *Treasurer*—C. H. Dow. The new committee chairmen were announced as follows: *Program*—D. W. Blair; *Membership*—H. L. Von Rehberg; *Social*—John Bonner; *Social Hour*—W. A. Williams.

Heating and air conditioning of railway passenger cars was the subject of the talk given by J. E. Haines, Vice-President, Minneapolis-Honeywell Regulator Co., Minneapolis. Required capacities and equipment arrangements were discussed, and early and present types of systems were compared. Attendance 42. Attendance ratio 0.39.

• MEMPHIS—May 16, 1949. *Advancement in Railway Car Heating and Ventilating* was described by M. R. Eastin, in a talk before the chapter. Mr. Eastin, sales manager of the Railway Controls Division, Minneapolis - Honeywell Regulator Co., was introduced by Pres. W. L. Wellford, Jr.

A report was made by C. S. Fischer, chairman of the meetings committee and C. E. Wynn, chairman of the auditing committee also reported. President Wellford spoke about a proposed city code.

Chairmen of other committees are: *Finance*—Roy W. Johnson; *publicity*—G. B. Richmond; *legislature*—L. D. Powell; *membership*—M. H. Ellis, Jr.; *advancement*—N. C. Ledbetter; *Guide*—R. E. Overman, Jr. Attendance 26.

• MINNESOTA—May 2, 1949. Prospects in business were described by O. C. Hognander, vice president in charge of sales, G. M. Tennant Co., Minneapolis, as he spoke at the May meeting in Minneapolis. Mr. Hognander derided many magic formulas in selling, and gave the fundamental points to be followed in merchandising.

Officers for the year 1949-50 were elected as follows: *President*—R. C. Jordan; *Vice President*—G. M. Kendrick; *Secretary*—E. F. Snyder, Jr.; *Treasurer*—William Sturm; *Board of Governors*—C. L. Bensen, C. P. Petersen.

The technical program for the Semi-Annual Meeting was outlined by A. V. Hutchinson, ASHVE secretary. Mr. Hutchinson also spoke on the growth of the Society during the past year. Reports were given by L. J. Krause, entertainment; O. L. Lilja, membership; B. F. McLouth, treasurer; and J. E. Haines, general chairman of Committee on Arrangements for the Semi-Annual Meeting. R. M. Balch, Jr., was in charge of group singing. Attendance 78.

• MONTREAL—May 23, 1949. *This Weather Business* was the keynote of the meeting which began at noon with Pres. S. W. Salter presiding. The speaker was G. H. T. Kimble, Ph.D., who gave highlights from his many years of experience in weather forecasting.

After the meeting in Montreal, the majority of the members went to Dorval for an inspection trip through the Dorval Airport Weather Bureau. Conducting the tour was Keith McLeod, who gave an interesting talk on weather forecasting. Attendance 24.

• NEBRASKA—May 17, 1949. A program for industrial expansion was outlined by Roy M. Green, University of Nebraska, in his talk before the chapter in Lincoln. Speaking on *Nebraska's Industrial Potential*, Mr. Green said that too much reliance should not be placed on agricultural commodities, since danger of drought was always present. He informed the group that the staff at the University of Nebraska had set up a committee to make plans for bringing industry into the state. Attedance 46.

• NORTHEASTERN OKLAHOMA—June 7, 1949. *Panel Heating* was the topic of the evening at the dinner meeting held in Tulsa, with H. A. Lockhart, chief engineer, Bell & Gossett Co., Morton Gove, Ill. as guest speaker.

A brief talk on meetings was made by Pres. W. R. Lee. The speaker for the evening was intro-

duced by R. W. Winget. Attendance 29. Attendance ratio 0.52.

• NORTHEASTERN OKLAHOMA—May 5, 1949. Alfred E. Stacey, Jr., Syracuse, N. Y., ASHVE President, who was guest speaker, described the progress made by the Society and outlined the research work undertaken by the ASHVE Laboratory.

Reports were made by Truman Allen, R. W. Winget, and L. S. Reagan. Pres. W. R. Lee read an abstract of the minutes of the April Council meeting. Three members of the Oklahoma A & M Student Branch were present and were introduced. Attendance 27.

• NORTH TEXAS—May 16, 1949. The reactions of individuals to sudden change in environment were described by Prof. Nathaniel Glickman, of the University of Illinois Medical School, Chicago. During his talk before the North Texas chapter gathered in Dallas, Professor Glickman answered numerous questions about the cooperative research work being conducted on the effect of sudden environment change.

A brief progress report on plans for the 1950 exposition to be held in Dallas was given by a representative of the International Exposition Co. Attendance 60. Attendance ratio 0.48.

• PHILADELPHIA—June 7, 1949. Retiring President J. O. Kirkbride received a bronze plaque from past president E. H. Dafter, who made the presentation on behalf of the Chapter. The plaque, bearing the emblem of the Society, was given to Mr. Kirkbride as a token of appreciation for the services he has rendered the Chapter during the past year.

President-elect F. H. Buzzard and the other new officers were introduced to the group. The meeting was turned over to the golf committee chairmen, W. P. Culbert and H. H. Erickson, who made the golf awards, the annual golf outing having been held earlier in the day. Attendance 104.

• ROCKY MOUNTAIN — May 11, 1949. A dinner meeting and a half hour entertainment program, including music, preceded the business meeting held at the Silver Wing Inn, Englewood, Colo.

The following new officers were elected: *President*—E. J. McEahern; *Vice President*—R. W. Petersen; *Secretary*—N. H. Brickham; *Treasurer*—A. W. Cooper; *Board of Governors*—Fred Janssen, B. A. Brickham, F. C. Allen.

The new officers of the Chapter were introduced and installed by L. M. Hook. Mr. McEahern received the gavel, and then presented lapel pins to the five past presidents of the Chapter. Past presidents J. F. Mohan, J. H. McCabe and Fred Janssen were present to receive their pins. Past presidents G. D. Maves and F. L. Adams were unable to be present. The secretary was instructed to transmit the pins to them with a letter expressing the appreciation of the Chapter for services rendered.

An auditing committee consisting of L. M. Hook, H. J. Woehlke, and J. J. Johnson was appointed. Two resolutions were also approved by the membership. Attendance 59. Attendance ratio 0.83.

• SOUTHERN CALIFORNIA—June 16, 1949. Members were entertained in Beverly Hills with a program emphasizing fire protection. Assistant fire chiefs Johnson and Randall were present to answer questions, and a color film entitled *Your Fire Department* was presented.

Pres. R. S. Farr presided over the meeting. The recently elected officers for 1949-50 were installed. Attendance 52.

• SOUTHERN CALIFORNIA—May 18, 1949. At the May meeting in Beverly Hills, the following officers were elected: *President* — J. L. Blake; *Vice President*—L. J. Helms; *Secretary*—M. C. Greiner; *Treasurer*—J. S. Earhart. The following were elected to serve on the *Board of Governors*—R. S. Farr, W. O. Stewart, Maron Kennedy, A. J. Hess, J. F. Park.

Speaker of the evening was W. L. Holladay of the Hieatt Engineering Co., Los Angeles. His subject was *Design of Industrial Test Chambers*. He gave an interesting discussion on test chambers ranging in size from one cubic foot to room size, with temperature and humidity conditions from −100 to 100 F. Attendance 65.

• VIRGINIA—May 18, 1949. A 40-minute movie describing the development of steam for power and showing various types of boilers was exhibited at the meeting in Norfolk.

Pres. J. E. White announced that this would be the last meeting until September. The minutes of the meeting on May 2 of the Board of Governors and committee chairmen were read. Attendance 18. Attendance ratio 0.66.

Student Branches

▲ CCNY—June 1, 1949. The election of officers for the fall semester 1949 took place at the Student Branch meeting in the College of the City of New York, with the following results: *President*—Norman Moskowitz; *Vice-President*—M. H. Segner; *Recording Secretary*—Seymour Oestreicher; *Corresponding Secretary*—R. A. Alpert; *Treasurer*—T. C. T. Roberts.

The officers elected were given a summary of their duties by the retiring officers. This being the last meeting of the semester, each chairman of the various committees gave a detailed report of the accomplishments and standings of his particular committee. Mr. Segner presented the financial statement. Attendance 25. Attendance ratio 0.55.

▲ OSC—May 23, 1949. A short business meeting was held on the cam-

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pus of Oregon State College, Corvallis, to elect officers for the school year 1949-50. The following officers were elected: *President*—M. B. Larson; *Vice President*—R. D. Reese; *Secretary-Treasurer*—Helen P. Lankow. Attendance 23. Attendance ratio 0.55.

▲ UNIVERSITY OF TEXAS—May 29, 1949. At the last meeting of the spring semester 1949 of the University of Texas Student Branch, election of officers for the fall semester 1949 was held as follows: *President*—D. S. Belvin; *Vice President*—A. G. Allen.

Cruising on the River With ASRE

Reported by Prof. Carl F. Kayan

EMULATING the now famous example of the 1946 ASHVE Semi-Annual Meeting—Saguenay Cruise, the *American Society of Refrigerating Engineers* held its Spring meeting June 5 to 9 aboard the S.S. Richelieu, similarly cruising the St. Lawrence and the Saguenay Rivers.

With the Ontario Section of *ASRE* as host, the 36th Spring meeting of the Society presented an innovation in that, for the first time in its history, the Refrigerating Engineers held a meeting on board ship and beyond the boundaries of the United States. The entire boat was chartered, and all the passengers were *ASRE* members, their families, and guests. The cruise started Sunday noon, June 5, from Montreal, and ended Thursday morning, June 9, back in Montreal.

In addition to an evenly balanced boat program of technical papers with discussions, committee meetings, and social activities such as dancing, games, and motion pictures, the trip included a day of sightseeing centered around the historic city of Quebec, as well as a visit to the Arvida Works of the Aluminum Co. and to the immense —comparable to Hoover Dam—hydroelectric plant at Shipshaw. The passenger list numbered about 350, many of whom had previously enjoyed the ASHVE voyage of three years ago, and were making the trip as a repeat performance.

Four technical sessions were held, starting with the first one on Monday morning well down the St. Lawrence, and ending with the last one on Wednesday evening after leaving Quebec. The last session was devoted to a Domestic Refrigerator Engineering Conference on refrigerator field testing.

A total of 10 formal papers was presented, among which may be cited the following: Moisture in Walls of Cold Storage Rooms, by Dr. Carl Munters, Sweden; Air Cycle Refrigeration and its Applications, by P. C. Scofield, AiResearch Mfg. Co., Los Angeles, Calif.; A New Canadian Laboratory for Arctic Testing, by J. L. Orr and D. G. Henshaw, National Research Council, Canada; Theory and Use of the Capillary Tube Expansion Device — Part II, Non-Adiabatic Flow, by M. M. Bolstad, University of Missouri, and R. C. Jordan, University of Minnesota; and New Development in Absorption Refrigeration, by Dr. A. A. Berestneff, Carrier Corp., Syracuse, N. Y.

Officers of the *ASRE* are: *President*—B. H. Jennings, Evanston, Ill.; *Vice Presidents*—J. G. Bergdoll, Jr., York, Pa.; and Edward Simons, San Francisco, Calif.; *Treasurer*—P. B. Christensen, New York, N. Y.; *Secretary*—M. C. Turpin, New York, N. Y.; and *Assistant Secretary*—Alfred Chadburn, Cincinnati, Ohio.

The Richelieu, theater of ASRE summer meeting activities

GURNEY RECEIVES DEGREE FROM CANADIAN UNIVERSITY

Making the convocation speech before a graduating class of nearly 900 students, E. Holt Gurney of Toronto, Ontario, received an honorary LL. D. degree from the University of Western Ontario, London, Ont. June 4, 1949.

Mr. Gurney, President, The Gurney Foundry Co., Toronto, and a past president of ASHVE, was awarded the degree on the basis of his ten years' chairmanship of the Ontario Research Foundation. His speech before the group described the foundation's work and the problems confronting it. The greatest single difficulty in operating any research group, Mr. Gurney said, was the difficulty in obtaining post graduate workers. He pointed out

E. Holt Gurney

that the reason for this difficulty lay in the tremendous growth in the size of universities both in Canada and in United States, with University personnel primarily occupied with the great burden of large undergraduate classes to the neglect of the post-graduate schools.

Presentation of the degree was made by Arthur Ford, chancellor of the University. Dr. G. E. Hall, President of the University, introduced Mr. Gurney.

Other honorary degrees were received by the following: Reginald Stewart, leader of the Baltimore Symphony Orchestra, Baltimore, Md.; Dr. W. R. Reek, president of the Ontario Agricultural College; and Dr. Septimus Thompson, professor of Ophthalmology at Western University.

GIANNINI ASSISTANT DEAN

Prof. M. C. Giannini, of the College of Engineering, New York University, New York City, has been recently appointed assistant dean in charge of the day division. He has been associate professor of mechanical engineering since 1943.

Professor Giannini has been executive assistant in the College of Engineering since 1946, while continuing a private consulting practice which includes design of heating, air conditioning and other equipment for buildings.

M. C. Giannini

As a member of the ASHVE, he is now on the Committee on Research, the Publication Committee and the TAC's on the Heat Pump and Sorbents. He is a past president of New York Chapter.

He belongs also to the American Society for Engineering Education and Tau Beta Pi and Pi Tau Sigma engineering fraternities.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 72 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by August 25, 1949, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

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OBITUARIES

EDWIN J. OSTERMEIER

Edwin J. Ostermeier, Chicago, Ill., was killed early in June 1949 when his automobile overturned. Mr. Ostermeier, 45 years old, was president of the Delta Engineering and Apex Engineering Companies, Chicago.

Mr. Ostermeier was born in Lancaster, N. Y. and was educated in the public schools of Buffalo. His career began in 1923 in service and sales of heating systems. In 1937 he became sales manager of the stoker division of Iroquois Coal Co., Chicago. In this capacity, he was responsible for some design and made two innovations in stoker manufacture.

In 1940, he organized his own concern, the G-O Engineering Service, doing research work before setting up his operational plan. In 1942, he combined his business with the Apex All-Weather Products Co., Engineering Division. This became the Apex Engineering Co., Chicago, which Mr. Ostermeier headed.

Mr. Ostermeier was a member of the Illinois Chapter of the Society. He is survived by his widow, Angela, and three children, Donald, Jeanette, and Angela.

JOHN J. LAWLOR

John J. Lawlor, Toronto, Ont., Canada, died of a heart attack during the last week in June 1949, at the age of 61.

Mr. Lawlor was born in Philadelphia, Pa., and was educated in Philadelphia public and technical schools. As a young man he went to Toronto.

In 1910 he joined the sales department of the James Robertson Co., Ltd., where his duties included drawing up specifications and plans of plumbing and heating installations.

In 1933, he was made manager of the heating division of the Robertson Co., having charge of the engineering and heating department, a position he held until the time of his death.

He joined the Society in 1935 and was active in the Ontario Chapter, where he was one of the oldest and most faithful members. He also belonged to the Professional Engineering Society of Canada.

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• **CENTRAL NEW YORK:** Organized 1944. Headquarters, Syracuse, N. Y. President, V. S. Day, 300 S. Geddes St., Syracuse 1. Secretary, J. H. Carpenter, 3515 Midland Ave., Syracuse 7.

• **CENTRAL OHIO:** Organized 1944. Headquarters, Columbus, Ohio. Meets, Third Monday. PRESIDENT, E. A. Norman, Jr., 1150 Chesapeake Ave., Columbus 12. SECRETARY, R. S. Curl, 80 S. Third St., Columbus 15.

• **CINCINNATI:** Organized 1932. Headquarters, Cincinnati, Ohio. Meets, First Tuesday. PRESIDENT, K. B. Little, 832 Temple Bar Bldg., Cincinnati 2. SECRETARY, D. J. Wood, 659 E. Sixth St., Cincinnati.

• **CONNECTICUT:** Organized 1940. Headquarters, New Haven, Conn. Meets, Third Thursday. PRESIDENT, Winfield Roeder, 405 Temple St., New Haven. SECRETARY, T. L. Arnold, 26 Francis Ave., Hartford.

• **DELTA:** Organized 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. PRESIDENT, R. B. Guest, 827-37 Dryades St., New Orleans 13. SECRETARY, Theodore Offner, 1000 S. Peters St., New Orleans.

• **GOLDEN GATE:** Organized 1937. Headquarters, San Francisco, Calif. Meets, First Thursday. President, H. V. Hickman, 1129 Folsom St., San Francisco 1. Secretary, R. C. Cushing, 1136 Howard St., San Francisco 3.

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• **INDIANA:** Organized 1943. Headquarters, Indianapolis, Ind. Meets, Fourth Friday. PRESIDENT, W. R. Fenstermaker, 937 Architects & Builders Bldg., Indianapolis 4. SECRETARY, F. C. Barton, 938 K of P Bldg., Indianapolis.

• **IOWA:** Organized 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. PRESIDENT, D. E. Wells, 304 Home Federal Bldg., Des Moines 9. SECRETARY, C. P. North, P.O. Box 833, Des Moines 4.

• **KANSAS CITY:** Organized 1917. Headquarters, Kansas City, Mo. Meets, First Monday. PRESIDENT, Henry Nottberg, Jr., 914 Campbell, Kansas City 6. SECRETARY, C. W. Schumacher, 1922 Grand Ave., Kansas City 9.

• **MANITOBA:** Organized 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. President, A. W. Moss, 268 Yale Ave., Winnipeg. Secretary, C. M. Fleming, 447 Main St., Winnipeg.

• **MASSACHUSETTS:** Organized 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. PRESIDENT, W. H. Shipp, 124 Lewis Rd., Belmont 78. SECRETARY, J. P. Licandro, 177 State St., Boston.

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• **MINNESOTA:** Organized 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. PRESIDENT, R. C. Jordan, University of Minnesota, Minneapolis 14. SECRETARY, E. F. Snyder, Jr., 4324 Zenith Ave., N., Minneapolis 12.

• **MONTREAL:** Organized 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. President, S. W. Salter, 3410 Trenholme Ave., Montreal. Secretary, J. G. Chenevert, 1010 St. Catherine St., W., Montreal.

• **NEBRASKA:** Organized 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. President, K. R. Magarrell, 127 So. Main St., Council Bluffs, Ia. Secretary, F. E. Prawl, 2820 Harney St., Omaha 2.

• **NEW YORK:** Organized 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, H. S. Johnson, 39 Cortlandt St., New York 7. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

• **NORTH CAROLINA:** Organized 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, DeParx Stimson, 121 Idlewilde Dr., Winston-Salem. Secretary, R. B. Crosland, Jr., 1001 S. Marshall St., Winston-Salem.

• **NORTH TEXAS:** Organized 1938. Headquarters, Dallas, Tex. Meets, Third Monday. PRESIDENT, G. A. Linskie, Buckner Blvd., Dallas 10. ACTING SECRETARY, R. G. Lyford, 2415 N. Pearl St., Dallas.

• **NORTHEASTERN OKLAHOMA:** Organized 1948. Headquarters, Tulsa, Okla. President, W. R. Lee, 303 Beacon Bldg., Tulsa 3. Secretary, R. F. Shoemaker, 1136 So. Peoria, Tulsa.

• **NORTHERN OHIO:** Organized 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. PRESIDENT, R. L. Byers, 1740 E. 12th St., Cleveland 14. SECRETARY, G. V. Parmelee, 94 Solon Rd., Chagrin Falls.

• **OKLAHOMA:** Organized 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, H. S. Shafer, 400 Key Bldg., Oklahoma City 2. Secretary, R. E. Swan, 117 N.W. First St., Oklahoma City.

• **ONTARIO:** Organized 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. PRESIDENT, A. J. Strain, 474 Bathurst St., Toronto. SECRETARY, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

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• **PACIFIC NORTHWEST:** Organized 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. PRESIDENT, J. D. Sparks, 7331 W. Green Lake Way, Seattle 3. SECRETARY, W. B. Pride, 3228 37th Pl., Seattle 44.

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• **SOUTHERN CALIFORNIA:** Organized 1930. Headquarters, Los Angeles, Calif. Meets, Third Wednesday. PRESIDENT, J. L. Blake, 1700 S. Bedford St., Los Angeles 35. SECRETARY, M. C. Greiner, 1559 Club View Dr., Los Angeles 24.

• **SOUTHWEST TEXAS:** Organized 194[illegible]. Headquarters, San Antonio, Tex. Meets, Second Tuesday. President, G. R. Rhine, 1208 Alamo National Bldg., San Antonio. Secretary, I. W. Wilke, P.O. Box 11[illegible], Austin 3.

• **UTAH:** Organized 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, C. E. Ferguson, 838 E. Garfield Ave., Salt Lake City. Secretary, A. L. Curtis, 2211 Highland Dr., Salt Lake City.

• **VIRGINIA:** Organized 1946. Headquarters, Norfolk, Va. President, J. E. White, 7607 Gloucester Ave., Norfolk 5. Secretary, D. E. Phillips, P.O. Box 674, Newport News.

• **WASHINGTON, D. C.:** Organized 193[illegible]. Headquarters, Washington, D. C. Meets, Second Wednesday. President, P. L. Achenbach, Connecticut & Van Ness St., Washington, D. C. Secretary, J. G. Muirhead, 2013 New Hampshire Ave., N. W., Washington 9.

• **WESTERN MICHIGAN:** Organized 192[illegible]. Headquarters, Grand Rapids, Mich. Meets, Second Monday. PRESIDENT, J. A. Alexander, P. O. Box 132, Station C, Grand Rapids. SECRETARY, L. A. Calcaterra, 1136-42 Plainfield Ave. N.E., Grand Rapids.

• **WESTERN NEW YORK:** Organized 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. PRESIDENT, F. J. Weber, 443 Delaware Ave., Buffalo 2. SECRETARY, J. M. Quackenbush, 610 Linwood Ave., Buffalo.

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For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1949 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Induced Draft Cooling Towers Offered for Indoor, Outdoor Use

No. 4107 — Kennard Corp., 1819 S. Hanley Rd., St. Louis 17, has developed a series of outdoor and indoor cooling towers in furtherance of a complete line of heat transfer equipment.

The new towers are of the induced draft type and are available in 3 to 75 ton nominal capacities (duplexed to 150 tons). The manufacturer claims many structural superiorities and operating economies. Built with hot dipped galvanized wheels and scrolls, frames and sump pans, these units include various features such as sectional construction, a "Penta-Post" frame providing a large number of access and service panels, and the use of stainless steel or phosphorous bronze fastenings throughout.

Combines Air Diffuser and Pendant Light

No. 4108—For use where architectural or decorative considerations require that an air diffuser and light fixture be located at the same spot in the ceiling, a modification of the "Kno-Draft" adjustable air diffuser is now available from W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16.

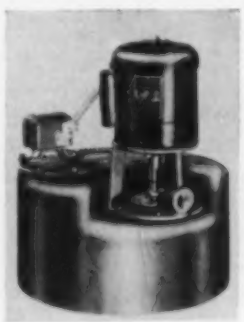
The diffuser is said to retain all of its functional features when combined with any pendant light fixture, and any size or type of diffuser, with or without the air volume damper or other accessories, may be combined.

Designs Condensation Pump and Receiver for Low Pressure Use

No. 4109—The type CV vertical condensation pump and receiver has an integral pump casing and motor stand of cast iron construction which is bolted to the cast iron receiver. The manufacturer is Skidmore Corp., St. Joseph, Mich.

The pump is bronze fitted and has an enclosed type centrifugal impeller which is said to be of special design for hot water use. The pump shaft is of stainless steel and the self lubricating bronze bearing is directly above the impeller. The motor is of the capacitor type, ⅓ hp, single phase, 60 cycle, 115/230 volt, 3500 rpm. Three phase and d-c motors are also available. The control is automatic and consists of an enclosed float switch of the double pole type. A vent and overflow connection is provided on the receiver which is said to be suitable for floor mounting or in a shallow pit. The pump is built in "single" units only. Three sizes of frames are available and capacities range from 500 to 10,000 sq ft EDR, for pressures from 10 to 20 psi.

Units are said to be ideal for returning condensation to the boiler and other points from all types of low pressure steam heating systems, process equipment, coils, etc.



Condensation Unit

Glass Fiber Insulation

Superfine Glass Fibers Used in Insulation

No. 4110—The newest addition to the family of "Fiberglas" insulations is "Aerocor," said to be made of superfine fibers and to combine extraordinary thermal insulating and sound absorbing characteristics with ease of handling and fabricating. The manufacturer is Owens-Corning Fiberglas Corp., Toledo 1, Ohio.

Available in a variety of densities and thicknesses to suit specific applications, the material is said to be designed for use where great thermal efficiency must be attained in the least space with practical assembly methods, and to be exceptionally light, resilient, and durable. According to the company, its unusual sound absorbing characteristics can be used to quiet the operation of

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Heating, Piping & Air Conditioning [8-49]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each number in which you are interested)

4107 4108 4109 4110 4111 4112 4113 4114 4115 4116
4117 4118 4119 4120 4121 4122 4123 4124 4125 4126
4127
7340 7341 7342 7343 7344 7346 7347 7348 7349
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7370 7371 7372 7373 7374 7375 7376 7377 7378 7379
7380 7381 7382 7383 7384 7385 7386 7387

Name..... Title.....
Company .....
Address .....
City..... Zone..... State.....

mechanical equipment. Individual fibers are said to be one quarter to one tenth the diameter of those found in other forms of the company's insulation.

Gas Burner for Scotch Marine Boiler Has Many Uses

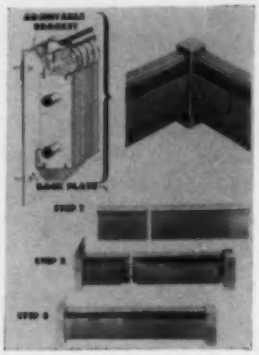
No. 4111—The "Kinetic" gas burner has been developed by Webster Engineering Co., Div. of Surface Combustion Corp., Tulsa, Okla., specifically for firing Scotch marine boilers with low pressure gas, without noise, vibration, or electrical power, and with minimum furnace draft.

Particularly recommended for use with the Kewanee "Scottie Junior" boilers, it is also said to be well suited to a variety of other applications, such as firing air heaters or any other type of "cold" furnace. It may be used either with or without standby oil equipment and is designed for practically all gases, from 530 Btu coke oven gas to 2550 Btu propane vapor.

The burner consists of a multiplicity of venturi mixers and flame retention nozzles assembled in a metal casing fitted with a metal flange which is bolted to the adaptor cover plate of the furnace. According to the company, stable ignition flame is obtained from the integral pilot consisting of a miniature venturi mixer and flame retention nozzle. A balanced multiple vane inlet louver is used to provide equal distribution of air for combustion.

Units are available in almost any practicable shape and size. The smallest burner has four heads and the largest, to date, has 56 heads. Capacities range from 560,000 Btu per hr to over 7,000,000 Btu per hr, based on a gas pressure of 4 in. of water. In addition to flexibility of shape, the burner is said to have great flexibility in capacity because it may be used with gas pressures up to 20 or 30 in. of water or even higher and may also be turned down to a pressure of 0.5 in. without flashback.

Radiant Baseboard Unit Designed for Easy Installation



No. 4112—A new radiant baseboard system said to need only three simple steps for a finished installation has been introduced by Kritzer Radiant Coils, Inc., 2901 Lawrence Ave., Chicago 25. Because of its basic simplicity, the company claims it to be extremely economical both in original cost and in labor costs.

The heart of the system is the radiant coils, 10 ft sections of 2 x 5½ in. aluminum fins mechanically bonded to two, 3 in. center, copper supply tubes. No fittings are required to join the ends of the copper tubing when installing the coils. As two sections are brought together, the supply ends in one section are belled, the ends of the other section being inserted into this bell. A solder ring is heated and melted between the two.

These **2 THERMOBLOCS**

... offer the Flexibility you need for Heating Your Plant!

Total outputs up to millions of b.t.u.'s per hour can be obtained with combinations of these two THERMOBLOC sizes. Units of these sizes, placed strategically throughout the plant, will maintain uniform temperatures without costly piping or duct work.

Original cost and installation of THERMOBLOC is approximately one-third that of other types of conventional systems, and a notably higher overall efficiency of 82 to 86% results in required temperatures at a lower fuel consumption rate.

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ONE No. 550 THERMOBLOC EQUALS
550,000 b.t.u.'s per hour
2290 sq. ft. of radiation
567 pounds of steam per hour
16.4 developed boiler horse power

ONE No. 300 THERMOBLOC EQUALS
300,000 b.t.u.'s per hour
1250 sq. ft. of radiation
309 pounds of steam per hour
8.96 developed boiler horse power

THERMOBLOC DIVISION

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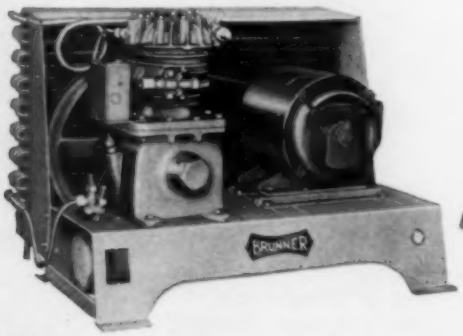

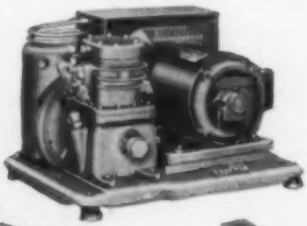

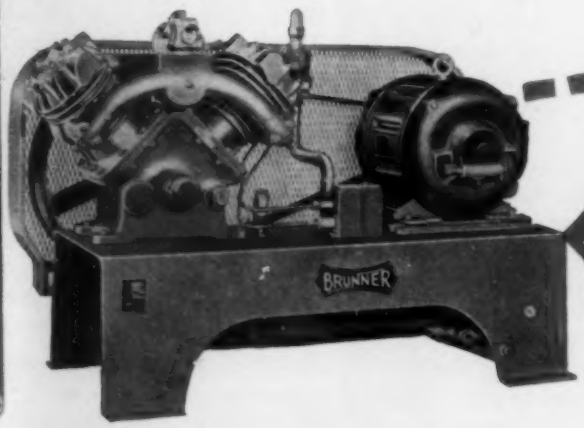

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¼ HP. TO 30 HP.

Now available in 42" and 48" SIZES WITH CAPACITIES UP TO 42,000 CFM

Here's positive, controlled ventilation at all times, regardless of wind or weather! Snow, ice, wind or rain have no effect upon the certified performance ratings of the POWER-FLOW. Exhausts more air per brake horsepower than other ventilators. May be used with or without duct system.

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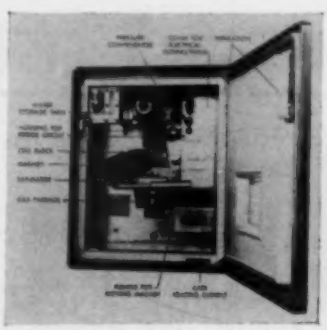
The system includes the steel back plate, the coils, filler plates, and the end posts which are interchangeable. Ornamental grilles are available if decoration is desired. One of the features of this system is said to be the fact that the coils "float" on hanging clips attached to the back plate. This, says the firm, leaves room for and promotes the free circulation of cold air behind the coil which in turn keeps the back plate cool, eliminating reverse losses and insulation.

Analyzes, Indicates, and Records Percent Oxygen

No. 4113—The "Magno-Therm" oxygen meter has been developed by Hays Corp., Michigan City, Ind., to continuously analyze, indicate, and record the percentage of oxygen in boiler flue gases and in industrial gases. It operates on the paramagnetic property of oxygen.

Gas is diffused through two cells containing heated resistors. A strong magnetic field is directed across one resistor and the oxygen bearing gas is attracted into the magnetic field and becomes heated by the hot resistor. The oxygen loses its magnetism as it becomes heated and is forced out of the magnetic field by the cooler, more magnetic oxygen. The cooling effect on the heated resistor is proportional to the magnetism of the gas entering the cell. This changes its electrical resistance and increases the flow of current through it. The change in flow of current is compared with the current flow in the comparison cell resistor and the difference in resistance is measured by the company's "Acratron" electronic type recorder, calibrated to read in percent oxygen. The measurement is said to be compensated for ambient temperature, barometric pressure, and variable moisture content of the gas.



Oxygen Meter

Diaphragm Valve

Valve Diaphragm Seals Bonnet Only

No. 4114—Crane Co., 836 S. Michigan Ave., Chicago 5, has introduced a line of diaphragm valves utilizing a new design principle that limits the diaphragm function to sealing the bonnet only.

A separate seating member, designed to give positive control of flow independently of the diaphragm, reduces the flexing to which the diaphragm is subjected and, according to the company, completely eliminates the diaphragm crushing action that is inherent in designs where the diaphragm itself is used to effect valve closure. Shutoff of flow is said to be positive at all times. Even in the event of diaphragm failure, fluid cannot pass on to the line when the valve is closed. Y pattern body design is used to give greater flow capacity.

Two types of valves are available, one plain iron and

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This Unique Insulation Product Has

NINE LIVES

★ SAVES FUEL

★ DEADENS METALLIC NOISE

★ OFFSETS OVERLOADS

★ IMPROVES APPEARANCE

★ REDUCES POWER LOAD

★ PREVENTS CONDENSATION

★ PREVENTS RUST

★ ABSORBS SOUND

★ REDUCES VIBRATION

Yes,* DUX-SULATION *performs nine important functions in any heating, ventilating and air-conditioning system . . .

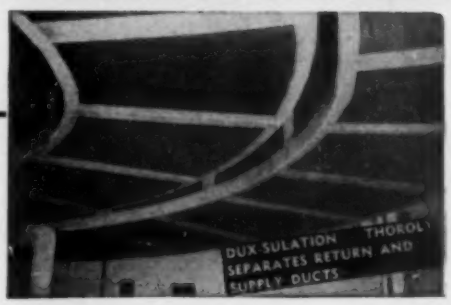
Asbestos-protected DUX-SULATION actually saves 75% of the heat loss that would otherwise be radiated from the ducts.

But, that's not all! DUX-SULATION performs many additional jobs, all of which are important in themselves—particularly the key functions listed to the left.

This unusual product can be applied to either the inside or the outside of round, rectangular, or irregular sized ducts. It is supremely flexible—will not chip, crack, or buckle. Furthermore, it is rot-proof, mildew-proof, and insect-proof.

DUX-SULATION is safe! The entire surface is protected with an asbestos membrane, and asbestos-protected tape is furnished for covering the corners and joints as well as adhesive for application. There is nothing else to buy —no wires, screws, bolts, or lugs are used. Comes in an easy-to-handle roll 36 inches wide—100 square feet ½" and 1" thick.

The greatest evidence as to the usefulness and durability of asbestos-protected DUX-SULATION is the fact that it is being used more widely each year, *and is specified again and again by leading Engineers and Contractors.*



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Mueller Climatrol Type 20 Gas-Fired Boiler. 43 sizes — A.G.A. input ratings from 189,000 to 3,780,000 Btu per hour.
Mueller Climatrol Type 10 Gas-Fired Boiler. 9 sizes— A.G.A. input ratings from 54,000 to 378,000 Btu per hour.
Mueller Climatrol Type 11 Gas-Fired Boiler. Same as type 10 except with controls exposed.

Mueller Climatrol Fuel-thrifty Gas Boilers

give you three advantages that sell your gas-boiler jobs

Whether you are selling in a competitive market or on jobs where price is not an important factor, you enjoy the confidence of your buyers when you specify Mueller Climatrol boilers. This is due to Mueller's national reputation for quality products.

Consider these advantages in handling Mueller Climatrol boilers:

- ✓ Complete line of sizes and models for every residential or commercial heating or hot water application. Units can be installed for steam, hot water or vapor systems.
- ✓ Attractive, compact units with designed selling features. Mueller boilers are easy to install and service, provide highly efficient, economical and dependable operation.
- ✓ Types 10 and 11 boilers are A. G. A. approved for L-P gases as well as natural, mixed, and manufactured gases. All conform to A. S. M. E. code for low pressure boilers.

L. J. Mueller Furnace Co., 2007 W. Oklahoma Avenue, Milwaukee 7, Wisconsin.

MUELLER Climatrol
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E-38

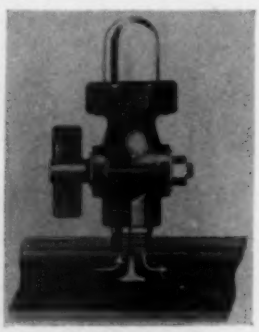
the other neoprene lined and coated. Both types have bolted bonnets. The plain iron valves are offered in sizes ½ in. to 2 in. inclusive, with screwed ends; and in sizes ½ in. to 4 in. inclusive, with flanged ends. The neoprene lined and coated valves are being made with flanged ends only, in sizes ½ in. through 4 in.

The new valves are recommended for use with compressed air, compressed and liquefied gases, hard-to-hold fluids, corrosive and noxious gases, for many types of corrosive process fluids, solvents, natural and corrosive waters such as mine water, sludges, slurries, fluids containing abrasive materials, and for pulp and paper mill liquors, sewage, etc. The plain iron valves are designed for services not exceeding 150 psi pressure and 180 F temperature. Temperature limitations on neoprene lined and coated valves are dependent upon service conditions and the fluids carried.

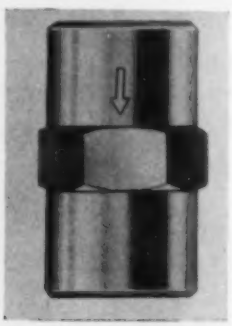
Sight Glass with Valve Shows Flow of Transparent Liquids

No. 4115—The clarity or turbidity of transparent liquids flowing under pressure through pipe lines can be observed by means of a valve type sight glass, designed and manufactured by Worthington Pump and Machinery Corp., Harrison, N. J.

Differential pressure is established across a deflector to allow some of the liquid to circulate continuously through a glass observation bowl which may be removed for cleaning. Originally designed for observing the clarity of hot water passing through the company's water treating systems, the sight glass can be used in any system through which transparent liquids flow.



Sight Glass



Flow Control Valve

Controls Water Flow Regardless of Pressure

No. 4116—Dole Valve Co., 1933 Carroll Ave., Chicago 12, is now in production on its flow control valve for providing a constant flow of water regardless of the pressure. Applications are said to include instantaneous water heaters, showers, washing equipment, and water softeners.

Previously this device has been offered only as an integral part of other company products. Now it is available as a separate unit. If water is drawn too fast from a tankless heater, the water is delivered at too low a temperature. With the flow control valve at the inlet, the amount of water passing through the heater can be limited to the rated capacity.

The unit consists essentially of a flexible orifice designed to vary its area in inverse proportion to the pressure. This, says the company, results in a constant control flow regardless of water pressure. Pressure ratings are from 15 to 150 psi.

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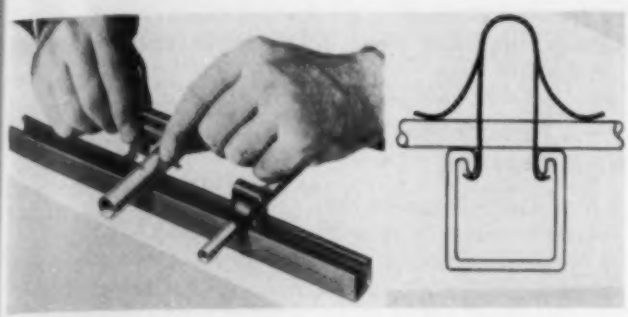
Clamps Tubing to Steel Channel

No. 4117—Unistrut Products Co., 1013 W. Washington St., Chicago, is now manufacturing a spring steel clamp designed for use with the firm's slotted steel channel to accommodate tubing sizes from 3/16 to 1 in. OD.

This new clamp, says the company, permits fastening of each tube individually, its respacing, relocation, or removal, all of which can be done in a matter of seconds. It is said to allow expansion and contraction, to hold tubing firmly in place, and to permit adjustment of tube mounting position.



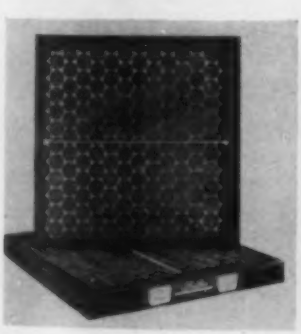
The combination of channel and clamp is said to provide flexibility of installation as the rack can be mounted or hung in any position, and where two pieces of channel are spot welded back to back, the tubing can be racked on both sides.

Glass Fibers Used in Air Filter

No. 4118**—A new impingement type disposable air filter made in 14 standard sizes for use on all types of forced air heating, ventilating, and air conditioning systems has been developed by Glasfloss Corp., 155 E. 44th St., New York City.

The filter element is said to be composed of long, fine glass fibers assembled in a fluffy, resilient mass with an intricate maze of air passages. The fibers are held together with a high temperature bonding agent and are coated with a special fire resistant adhesive.

According to the company, the smaller diameter of the individual fibers provides a greatly increased surface area in the filter pack and increases dust capacity. Other features are said to include low resistance to the passage of air and the fact that the glass fibers are both fire resistant and vaporproof.



Glass Fiber Air Filter

Metals Comparator

New Test Head for Metals Comparator Facilitates Use

No. 4119—More extensive application and wider utility are claimed for the metals comparator of General Electric Co.'s special products division, Schenectady 5, N. Y. For

for • SPRAYING
• WASHING
• RINSING
• COOLING
• AIR CONDITIONING

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Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

Wide range of standard sizes and capacities. Cast or machined from solid bar stock.

Thousands in use. Write for Bulletin N-616.

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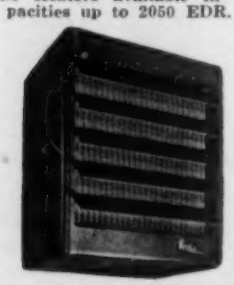
FOR HIGH OR LOW Ceilings

Showing installation of Fedders Unit Heaters in large railway maintenance machine shop.

Fedders Series 16 Downblow Unit Heaters available in capacities up to 2050 EDR.



Fedders Series 15 Horizontal Unit Heaters are built in capacities up to 1000 EDR.

• You will find it easier to standardize on the complete line of Fedders Horizontal and Downblow Unit Heaters for normal and high ceiling installations.

Your reputation is backed by Fedders 53 years of specialized heat transfer experience.

Customer satisfaction is spontaneous and contagious wherever Fedders Unit Heaters are installed to meet the exacting conditions of industrial and commercial heating requirements everywhere.

Whether ceilings are high or low specify Fedders.

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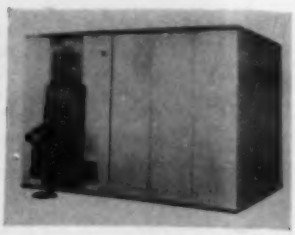
use on flat surfaces, particularly of large equipment, a new comparator test head has been developed for those instances in which the conventional test unit, the test coil, is inapplicable.

By comparing ferrous or nonferrous metal parts with a known standard, the device is said to provide a quick, nondestructive test of the quality of the parts. It enables an operator to maintain control on such characteristics as composition, heat treatment, or hardness.

The equipment consists of an electronic unit mounted in a steel cabinet and a test unit; either a coil for small metal parts or the new test head. The electronic unit includes a balancing network, oscillator, and indicator. It operates on single phase, 60 cycle, 110 volt commercial supply.

Steel Furnace Has High Capacity

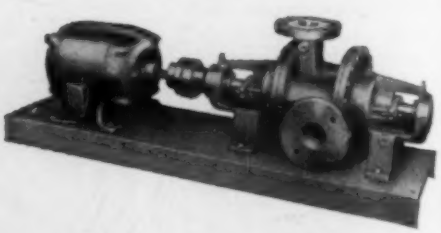


No. 4120—Designed expressly for schools, churches, garages, public, and commercial buildings, the "Hi-Cap" steel furnace is oil fired and is offered by Syncromatic Corp., Watertown, Wis.

It is available in various sizes from 350,000 to 1,000,000 Btu per hr at the bonnet. All parts of the heat exchanger are made of 3/16 in. steel plate with double welded seams, both inside and outside, on all surfaces subject to radiant heat. The counterflow principle of heat transfer is used and v type flues are used in the compound heating surface. The blower may be placed on either side of the furnace and special cfm requirements or blower applications can be arranged. According to the company, thermal efficiencies are in excess of 80 percent.

The v type construction of the heat exchanger is said to eliminate expansion noises. The exchanger can be furnished either knocked down so all parts will pass through a 36 in. door or in a solid seamless, one piece unit.

Turbine Type Pump Designed for High Temperature, Volatile Liquids



No. 4121—Aurora Pump Co., 80 Loucks St., Aurora, Ill., is offering a line of single and two stage "Apco" water jacketed, turbine type pumps for handling high temperature and highly volatile liquids.

Outstanding features, says the company, include notable performance on high head, small capacity duties, hydraulic balance, no metal-to-metal contact within the pump, and practically constant capacity over a wide head variation. The water jacketing and deep stuffing boxes are said to reduce the temperature of any liquid leakage so as to prevent the flashing or vaporizing of the leakage. The company also states that the pump will not vapor bind.

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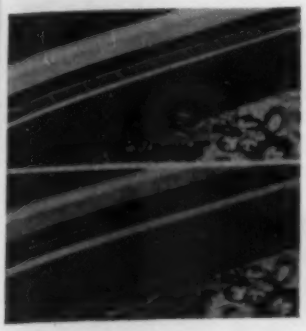
New Deflector Features Improved Baseboard Unit

No. 4122—Rittling Corp., 1292 Niagara St., Buffalo 13, is offering a new and improved type of baseboard heating unit designed to maintain an output of 600 Btu per hr per lineal foot with 170 deg forced water.

The low cost unit features utility of design and simplified installation. A new type of deflector with front opening is said to harmonize with room interiors and to eliminate the appearance of baseboard heating. Covers and deflectors are fabricated in 6 in. increments to eliminate on-the-job cutting or sawing and to reduce installation time and cost. Extra wide joining pieces provide allowance for variations in fitting the cover and deflector to wall sizes.

Radically new construction of brackets, says the company, prevents the core from contacting the cover or deflector, thus eliminating noises due to expansion and contraction. Elements are of continuous copper tubing with aluminum fins.



Baseboard Unit

Adjustable Wrench

Combines Open End Adjustable and Detachable Socket Wrench

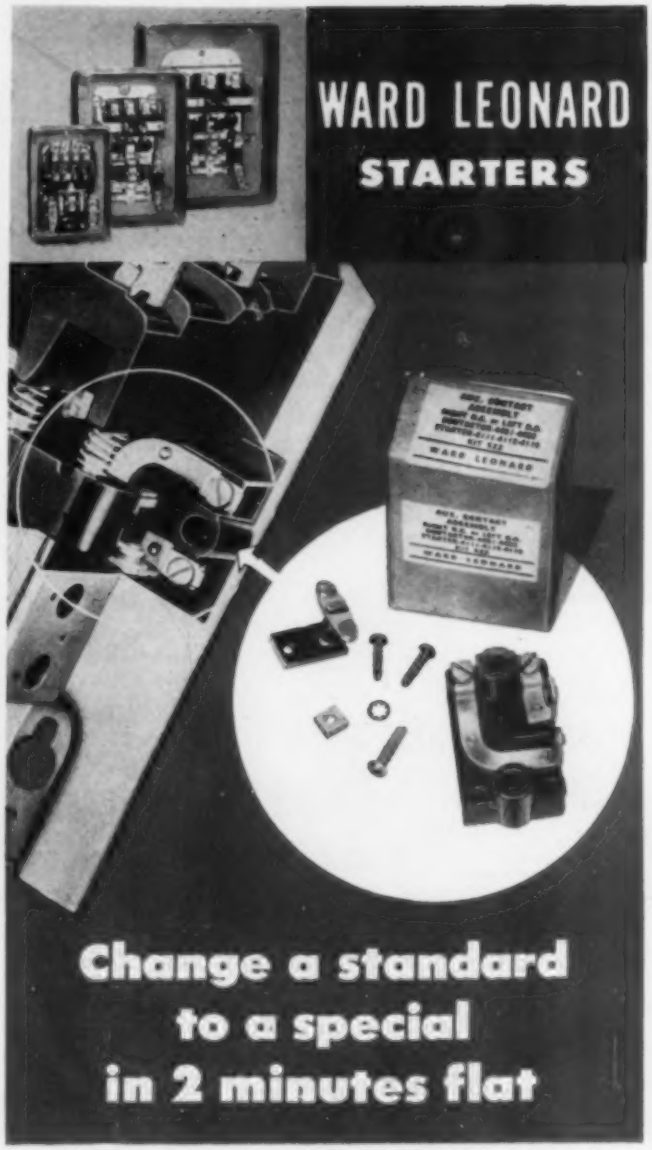
No. 4123—According to J. H. Williams Co., 400 Vulcan St., Buffalo 7, its adjustable "Crowfoot" attachments combine, through the medium of one tool, the flexibility of the detachable socket system with the advantages of the open end adjustable wrench.

The attachments, when used with the numerous handles and parts available, are said to present a variety of combinations which previously did not exist. Units are made from alloy steel in two square sizes, ⅜ and ½ in., with capacities of ¾ and 15/16 in. respectively. Square shoulders on the body portion of the jaw are designed to provide maximum and positive bearing against working stress.

Speeds Operation of Air Cylinders

No. 4124—Production increases combined with lower costs are claimed for a new type of valve installation centered around the new "Full-Flo" master valve developed by Ross Operating Valve Co., 120 E. Golden Gate, Detroit 3.

For controlling air operated cylinders, two 3-way valves, one normally open and one normally closed, are placed at each end of the cylinder. Operation is effected by a conveniently located, small pilot valve which can be manually, mechanically, or electrically actuated. This arrangement, says the company, permits the elimination of the long lengths of large diameter pipe between the valve and cylinder which would have to be filled and exhausted with nonproductive air. Air supply is received by the pilot valve and dispatched to the master by means



Because basic design permits easy conversion

To reduce the number of control components carried in Original Equipment Manufacturer's stock, Ward Leonard offers auxiliary contact kits.

All parts including necessary hardware are packaged for quick identification, convenience in stocking and fast unit assembly. No special tools needed.

Auxiliary contacts can be assembled on all size 1, 2 and 3 solenoid starters. Available as normally open or normally closed contacts for right or left hand mounting.

Write Ward Leonard Electric Company, 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WARD LEONARD ELECTRIC COMPANY
Result-Engineered Controls
RESISTORS · RHEOSTATS · RELAYS · CONTROL DEVICES

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★ NEARLY ALL BUILDING MATERIALS "Sponge-up" HEAT RAYS

"As a matter of fact, practically all materials used in building construction—brick, stone, wood, paper and so on—regardless of the color to visible light, are over 90% black for infra-red radiation. Therefore, air spaces within building walls are bounded by materials which are *good absorbers of the radiation* which impinges on them."

DR. J. L. FINCK, in the January 1935 "Architectural Record."

AND, F.H.A. Tech Circular No. 7 says on Page 18: "The *ordinary* surface has an *emissivity of 90 per cent.*" (The italics are ours in both quotations.)

★ INFRA INSULATION Blocks HEAT RAYS

★ CHECKS CONVECTION CURRENTS
★ MINIMIZES CONDUCTION
★ BARS MOISTURE AND VAPOR

The aluminum surfaces of Infra *transmit* or *emit* by radiation only a *negligible percentage* of heat actually absorbed by conduction, convection, and radiation; only 3% against 90%, or 1/30th the radiant heat absorption, and 1/30th the emissivity, or ability to transmit heat rays, of ordinary insulation. The slight mass—1 to 500 of low-conductive air—practically eliminates conduction. Scientific compartmentation and construction prevent the flow of convection currents.

Infra C Factors and Rockwool Equivalents
C.052 Heat Flow Down, equals 6" Rockwool.
C.083 Heat Flow Up, equals 4" Rockwool.
C.10 Lateral Heat, equals 3½" Rockwool.

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MULTIPLE ACCORDION ALUMINUM and TRIANGULAR REFLECTIVE AIR CELLS

Infra INSULATION, INC.
10 Murray St., N. Y., N. Y.

of tubing. The resultant saving in air with every movement of the piston is said to appreciably lower operating costs, and the close coupling of the valve to the cylinder is said to increase production because it permits quicker exhaust dumping and consequent faster movement of the cylinder piston.

The new mounting method is recommended for use with valves of ½ in. or larger, or with smaller sizes where increased operating speed is required. The master valve is available in ¼ in. through 1¼ in., straightway or 3-way, normally open or closed. For short stroke, double acting cylinders, 4-way master units can be supplied.

Stoker Has Device to Warn of Water in Gearcase

No. 4125—Brownell Co., 408 N. Findlay St., Dayton 1, Ohio, is offering a type F worm feed stoker which features a special oil level cup designed to give warning of water in the gearcase due to vapor condensation and other causes.

Another exclusive device is said to be the belt adjustment whereby the belt can be shifted from one pair of sheave grooves to another for changing speeds. The stoker is made in seven capacities with three styles of retorts. Air volume control can be manual or automatic. A gas repellent valve is said to assure freedom from gas and smoke blow-back.

Worm Feed Stoker

Manual Motor Starter

Manual Starters Used with Single or Polyphase Motors

No. 4126—Ward Leonard Electric Co., Mount Vernon, N. Y., is now offering Bulletin 3151 Size 0 and 1 a-c manual across-the-line starters designed for application with single or polyphase motors.

Said to be compact in construction, these units consist basically of a mechanically actuated quick make and break switch mechanism with thermal overload protection. Components are housed in NEMA Type 1 General Purpose Enclosures. Outstanding features, according to the company, include front operated, silver-to-silver double break contacts, manually reset inverse time delay thermal overloads, interchangeable overload heaters, provision for padlocking, and adequate wiring space.

Starters are available in 2-, 3-, and 4-pole forms. Maximum enclosed three phase rating for size 0 starters is 2 hp, 440-550 volts, 60 cycles and for size 1 starters 7½ hp, 440-550 volts, 60 cycles.

Convector Mounted on Building Walls

No. 4127—C. A. Dunham Co., 400 W. Madison St., Chicago 6, has developed a new low height, sloping top, wall type convector 10⅜ in. high and 5½ in. wide made

in lengths from 2 to 6 ft in 6 in. increments. Capacities are from 13.9 to 53.2 sq ft EDR with 1 psi steam and 65 F entering air.

Units may be used on either steam or forced circulated hot water installations at working pressures up to 150 psi. A series of these units may be installed to form one long continuous convector, a sheet metal "splice plate" being used to conceal the pipe connections between each unit. The cabinet has a removable front which includes a horizontally slotted outlet grille. This convector is available with the choice of three types of 1¼ in. finned pipe heating elements; steel pipe with steel fins, steel pipe with aluminum fins, or copper pipe with aluminum fins. The brackets supporting the heating element are adjustable to vary the pitch or grade as much as 1½ in. in either direction.

Equipment Shorts

The new Santa Clara, Calif., plant of **Owens-Corning Fiberglas Corp.**, Toledo, is now turning out building and industrial insulation materials. At a later date it is planned to install equipment for the production of shipboard insulation, duct insulation, and acoustical tile. Products made in the plant will be marketed in all states west of the Rockies. . . . **Worthington Pump and Machinery Corp.**, Harrison, N.J., has expanded and transferred its water treating equipment sales division to its Dunellen, N.J., works where facilities are said to be particularly well suited to this type of manufacture.

At the recent National Oil Heat Exposition in Boston, **Bell & Gossett Co.**, Morton Grove, Ill., was judged to have the most outstanding exhibit. Presentation of a plaque award was made to Ralph A. Patterson, sales manager. . . . **American Structural Products Co.**, a subsidiary of **Owens-Illinois Glass Co.**, Toledo, has acquired all of the industrial and electronics manufacturing facilities formerly centered in the **Kimble Glass Division** of the company and is continuing to manufacture glass block. Facilities for manufacturing "Kaylo" insulating materials have been turned over to Owens-Illinois. These changes group the manufacturing of all pressed glass items under American Structural Products Co.

Selas Corp. of America, Philadelphia, has taken over the industrial dehumidification equipment activities of the equipment section, engineering division, **Davison Chemical Corp.**, Baltimore. R. S. Van Note, formerly manager of the equipment section, has joined Selas as manager of its dehydrator division. . . . **Lincoln Electric Co.**, Cleveland, has completed final arrangements with The Austin Co. for the immediate construction of an $8.5 million plant to be erected in Euclid, Ohio. All manufacturing operations will be transferred to the new plant.

The **Superior Sheet Steel Div., Borg-Warner Corp.**, Canton, Ohio, has discontinued operations indefinitely. According to the company, it has served its purpose of supplying other plants of the parent corporation with steel during the shortages of the last two years. Moreover, a source of supply of semi-finished steel could not be found that would enable the division's hand sheet mill to compete with modern strip mills. . . . A series of conference type sales meetings were held in 43 districts throughout the country last month by **Frigidaire Div.**,

14 DISTINGUISHED FEATURES—here is the finest ceiling-type kitchen ventilator you have ever seen or heard! It's easy to install. It's automatic in operation. It's simple to clean (grille, motor and fan unit just lifts off). It has large Cfm capacity combined with super-quiet operation. It has a new hinged grille, motor and fan assembly (easily removed and replaced for cleaning) with built-in electrical plug which automatically breaks circuit when unit is removed. It has an insulated outer door with new spring booster control. This is just PART of the story—call nearby Branch Office (consult classified directory) or send coupon for complete details!

HURRY! GET FREE NEW BULLETIN!

ILG ELECTRIC VENTILATING CO.
2841 N. Crawford Ave., Chicago 41, Illinois

☐ Rush Bulletin No. 523 on new 10" Ceiling Ilgette Kitchen Ventilator.

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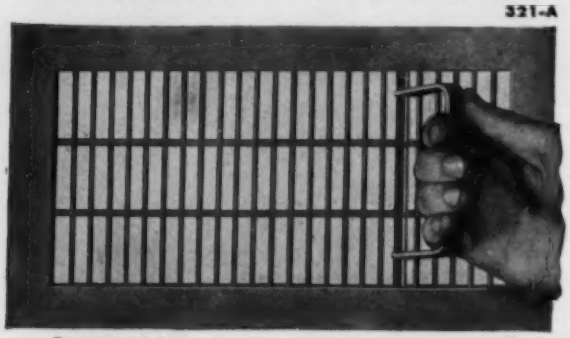
"Fabrikated" WALL GRILLES for Commercial Installations

PROVIDE ADJUSTABLE DIRECTED AIR FLOW

321-A



UP OR DOWN

RIGHT OR LEFT

311-A

Made to fit openings in even inches from 8" x 4" to 60" x 40"

Independent Fabrikated* Adjustable Grilles (patented), rigidly constructed with stamped steel rims and steel bars, are made with either vertical or horizontal grille bars. Grille bars are *adjustable* before or after installation; available also with bars permanently set for straight flow.

Write for new Catalog No. 48—gives schedule of sizes, details and prices.

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*Reg. U. S. Pat. Off.

THE INDEPENDENT REGISTER CO.

3747 E. 93rd STREET · CLEVELAND, OHIO

General Motors Corp., Dayton. Meetings were designed to serve as a mid-summer stimulant for commercial refrigeration and air conditioning sales.

A new building to house the Chicago branch of **Fairbanks, Morse & Co.** is now under construction at 1544-1558 S. State St. It will house the sales and service personnel, along with warehousing and repair facilities for the firm's operations in the Chicago area. When completed, the structure will represent an investment in excess of half a million dollars, will be of modern architecture, and will be automatically heated and air conditioned. . . . **E. I. du Pont de Nemours and Co., Inc.**, Wilmington, Del., has made substantial reductions in the prices of its trade sales paints which include those for household and maintenance finishes.

A battery of eight new soaking pits has been installed at the Brackenridge, Pa., plant of **Allegheny Ludlum Steel Corp.** The new pits, which are adjuncts to the new electric furnace department, have a capacity of 50 to 60 tons each, depending on the size and shape of ingots. . . . A group of Cincinnati's leading architects, engineers, and heating contractors were recent guests of **Aramac Supply Co.**, Cincinnati. Frank C. Hackett, sales promotion manager, **Bell & Gossett Co.**, was the speaker of the evening and discussed radiant panel heating.

The present manufacturing, office, and research facilities of **Landis Machine Co.**, Waynesboro, Pa., have been increased by approximately 50,000 sq ft. New machines and tools have also been installed. . . . Eighteen companies manufacturing perlite, a lightweight aggregate used in the building industry, have formed a national trade association, the **Perlite Institute**, with headquarters at 35 W. 53rd St., New York 19. Executive secretary is Wharton Clay, a former secretary and engineer of the National Mineral Wool Association. . . . Masons in the Brier Hill plant of **Youngstown Sheet and Tube Co.**, Youngstown, Ohio, recently received a company plaque for chalking up a million man hours without a disabling injury, the last injury being in March 1947.

The oil burner compressor of **General Electric Co.**, Bloomfield, N.J., is a combination oil pump and air compressor for low pressure atomization of oil for combustion. Oil and air are raised to 15 psi in the compressor and are discharged into a sump below the compressor. Since oil consumption is not necessarily the oil pumping rate, a float in the sump operates an oil bypass valve. Recently, Samuel J. Levine, manager of engineering of the firms's air conditioning department, was granted his seventh patent relative to oil burner compressors. His newest invention eliminates the float.

The initial synthesis of two new glycols has been completed by **Carbide and Carbon Chemicals Corp., Unit of Union Carbide and Carbon Corp.**, 30 E. 42nd St., New York 17. They are said to be of special interest in the manufacture of maleic and other alkyd resins, plasticizers, and elastometers, and to be useful as coupling agents and as solvents for protective coatings, hydraulic fluids, duplicating fluids, metal cleaners, and adhesives. Properties are also said to suggest their use as softeners or plasticizers for casein, zein, and other water soluble resins.

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At the recent annual convention of the American Waterworks Association, **Calgon, Inc.**, Pittsburgh, put on a demonstration which utilized iron samples, copper strips, and plain tap water to show how its chemical compound for treating water prevents corrosion. This is said to be the first time that current flow resulting from galvanic action was used to indicate the company's process of corrosion control. . . . **Telecomputing Corp.**, 2901 Hollywood Way, Burbank, Calif., has been organized to combine engineering research with automatic electronic calculating machines to compute numerical values and problems essential to converting theory and design into production. The firm has developed special equipment for reading data from graphs, film, or tape records and converting results directly into punched card form suitable for arithmetical analysis. Problems handled by the firm include load and stresses in steam lines and gears, vibration studies, and the reading and computation of gas flow temperature and pressure oscillograms.

"Lost-Wax" precision castings by the investment method are phenomenally accurate, according to **Precision Metalsmiths, Inc.**, 6509 Cedar Ave., Cleveland 3. Utilizing wax patterns, numerous types of castings are produced in brass, aluminum, beryllium, copper, beryllium-nickel, magnesium, and steels of various specifications. Dimensions of ±0.002 are said to be commonplace and occasionally dimensions are held to 0.0005. Castings are said to be particularly economical where considerable machine work may otherwise be involved.

Standard Pressed Steel Co., P. O. Box 810, Jenkintown, Pa., has developed a new "Unbrako" socket pressure plug with the "Dryseal" pipe thread. Designed to seal pressure-tight without the use of sealing compounds, it is said to be suitable for high pressure equipment of all kinds. It is made of alloy steel and is available in sizes from 1/16 to 2 in. . . . "Unimount" motors, in sizes from ½ to 500 hp, have been designed by **U.S. Electrical Motors, Inc.**, 200 E. Slauson Ave., Los Angeles 54, especially for direct connection to driven machinery. They are said to be particularly suitable for use with pumps, compressors, blowers, machine tools, etc.

Air Reduction Sales Co., 60 E. 42nd St., New York 17, is offering a new oxygen and acetylene cylinder leasing plan designed for small volume users. The 122 ft capacity oxygen cylinder is combined with a 60 ft acetylene cylinder and is offered on lease for a 25 year period. Empty cylinders may be exchanged for a new pair of full ones. . . . Designed for attachment to any drafting machine, the "Perspect-O-Metric" instrument developed by **Charles Bruning Co., Inc.**, 4754 Montrose Ave., Chicago 41, is said to automatically guide the draftsman's pencil toward the established vanishing points in perspective drawings. Special scales are used to reduce distant portions of the subject to their correct proportions. The device has three scale arms and may also be attached to parallel ruling straight edges.

Calculators Specialties Co., 122 S. Michigan Ave., Chicago, is again manufacturing its heating calculator which was developed by B. A. Johnson. It is a slide rule type of instrument designed for use in determining heat loss, radiation, duct sizes, etc.

COMMERCIAL HOPPER MODELS
feeding up to 1000 lbs. per hr.

Factories, plants, shops, stores, theaters, hotels, apartment houses, other large private and public buildings . . . all use *big quantities* of heat, hot water or steam . . . all can show *staggering fuel costs!*

Yet you can cut those costs . . . cut them up to 30% . . . with Combustioneer Automatic Coal Stokers. Think of that saving . . . monthly . . . or *yearly!*

Combustioneer gets *all* the heat *out* of the coal. Its exclusive "Pulsating" Transmission, Automatic Respirator and "Breathing" Fire-Bed assure highest efficiency combustion under all conditions and provide perfectly controlled automatic heat. And Combustioneer's extremely rugged design and construction pay off in long-lived dependability and lowest maintenance cost.

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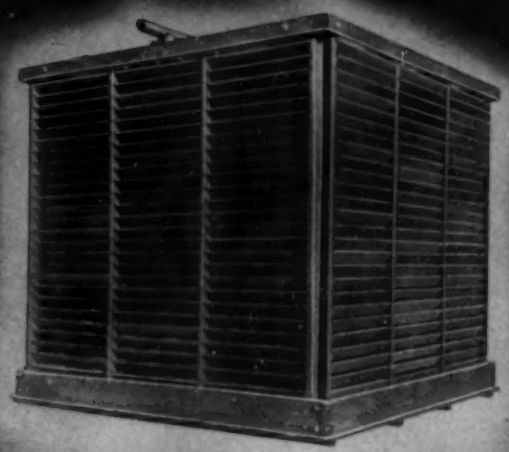
SPECIFY MARLEY
Series 200
FOR AN
ENGINEERED SPRAY TOWER



If you need a cooling tower that

May be expanded at any time
Is pre-fabricated for easy erection
Can be erected by semi-skilled labor
Has complete Erection, Operation and Maintenance Instructions
Is assembled with heavy galvanized bolts
Is made of Heart Quality Redwood
Has double vertical columns
Is designed to withstand 100 mph wind
Has slip-fit louvers
Has complete basin with sump and automatic valve
Is designed with a balanced spray system
Has patented Marley Spray Nozzles
Will give long trouble-free service
Has Atmospheric Sections as optional equipment
Can be installed in an open location

YOUR BEST BUY is a MARLEY SERIES 200

Series 200 atmospheric spray towers are designed to meet the requirements of dairies, locker plants, air conditioning and thousands of other applications where low first cost is a "must."

By installing standard Atmospheric Sections in a Series 200 Cooling Tower various fluids may be cooled indirectly. Series 200 Coil Towers are especially desirable for Engine Jacket Cooling, Diesel Engine Cooling, Quench Oil Cooling, and for many other similar applications.

Ask for a MARLEY Factory-Trained APPLICATION ENGINEER to tell you how the SERIES 200 will help solve your air conditioning and water cooling problems. No cost or obligation.

MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC.
Kansas City 15, Kansas

WHO'S WHAT

Hobart C. Ramsey, who joined **Worthington Pump and Machinery Corp.,** Harrison, N. J., in 1920 as a sales engineer in the export department, is the new president. He succeeds **Clarence E. Searle,** now vice chairman of the board of directors. Succeeding Mr. Ramsey as executive vice president is **Edwin J. Schwanhausser,** vice president in charge of sales since 1945. **John J. Summersby,** assistant vice president and general sales manager, succeeds Mr. Schwanhausser, and **Thomas J. Kehane** takes over the post vacated by Mr. Summersby. . . . Following the recent retirement of **W. Warren Rhodes, Dr. Edmond G. Young** is in charge of sales of the "Freon" fluorinated hydrocarbon propellants of **Kinetic Chemicals, Inc.,** Wilmington, Del. . . . The June issue of Milwaukee Engineering presented as "engineer of the month" **Dr. E. A. Uehling,** founder of **Uehling Instrument Co.,** Paterson, N. J. He recently celebrated his 100th birthday.

C. Milton Wilson is the new sales manager of **Anemostat Corp., of America,** New York City. He was formerly manager of sales, Ingersoll Steel Div., Borg-Warner Corp. and was also associated for many years with Clyde R. Place, consulting engineer, on major New York building projects. . . . **Herman Nelson Corp.,** Moline, Ill., has named **C. A. Pickett** Chicago regional sales manager. He is supervising sales activities in the Detroit, Saginaw, Grand Rapids, Indianapolis, Milwaukee, St. Louis, and Chicago territories. **Lester D. Linehan** has been appointed manager of the Chicago branch office. He had been Chicago branch manager for Penn Electric Switch Co.

C. A. Dunham Co., Chicago, has announced a number of changes in its sales organization. In Detroit, **W. H. Baldwin,** sales engineer, has retired and is succeeded by **C. C. Grubb** who has relinquished his Akron, Ohio, post to **William W. Evans.** In Louisville, **Wallace Hoeing** has retired from all business activity after 37 years as a sales engineer. He is succeeded by **David J. Rank,** formerly located in Indianapolis. Sales Engineer **R. K. Rouse** of Greenville, S. C., has established an office at Columbia, S. C., with **W. M. Plowden** as local manager.

Dr. Alfred Otto C. Nier, first man to isolate uranium 235 has become associated with **Minneapolis-Honeywell Regulator Co.,** Minneapolis. The board of regents of the University of Minnesota, where he is a professor of physics, has approved a contract permitting the physicist to work with the company as a consultant on research and engineering problems. **John R. Lenox** has been named manager of the company's industrial relations and the personnel department. **Sherwood M. Sitz,** who has been directing industrial relations at the firm's Minneapolis factories, has been promoted to director of industrial relations in a consulting capacity for the entire organization, including subsidiary companies. **George B. Benton,** who has been personnel manager, has been transferred to the expanded insurance department. . . . First place honors for technical literature went to **Tube Turns, Inc.,** Louisville, at the recent annual convention of the **National Industrial Advertisers Association.** The award was given to Piping Engineering papers written

under the supervision of **J. D. Mattimore,** director and chief engineer of the product engineering and research department. **Gene Wedereit,** director of advertising, handled the graphic arts phase of the project.

Cutler-Hammer, Inc., Milwaukee, has appointed **W. R. Reinhold** as manager of refrigeration sales to succeed **R. M. Van Vleet** who recently retired after 45 years of service with the company. Mr. Reinhold has been assistant manager of refrigeration sales. . . . **Games Slayter,** vice president and research director, **Owens-Corning Fiberglas Corp.,** received the honorary doctor of engineering degree from **Purdue University** at his alma mater's 91st commencement exercises. **E. W. Pat Smith,** who joined the company in April as special assistant to the general sales manager, is now director of merchandising. **Edward C. Ames,** who has been director of advertising on an interim basis for two years, has been named director of public relations and publicity. **Benjamin Foster Co.,** Philadelphia, has established a new division to handle "Fiberglas" industrial insulations for both hot and cold applications. **George W. E. Foster,** vice president of the 39 year old firm, is in charge.

Westinghouse Electric Corp., Pittsburgh, has made a number of recent executive changes. **Tomlinson Fort,** who formerly managed central station sales activities, is now manager of the apparatus sales department. **William W. Sproul,** sales manager for the transformer division at Sharon, Pa., is the new sales manager, industrial products and engineering manager of industrial products is **Royal C. Bergvall,** for the last 11 years assistant to the vice president in charge of engineering. The posts now held by Messrs. Sproul and Bergvall are newly created staff positions. . . . **Baltimore Aircoil Co., Inc.,** Baltimore, has elected **Mrs. M. K. Kok** treasurer. She has been with the firm since April 1947.

A new director of **Allegheny Ludlum Steel Corp.,** Brackenridge, Pa., is **John W. Belanger.** He is assistant general manager of the apparatus department, General Electric Co., and succeeds **H. V. Erben,** GE vice president who resigned. . . . **James T. Buckley** was president of **Philco Corp.,** Philadelphia, from 1939 to 1943 and has since served as chairman of the executive committee. Recently, he succeeded the late **John Ballantyne** as chairman of the board of directors. **William Balderston** continues to serve as president and **James H. Carmine,** vice president - distribution for the last two years, has been elected executive vice president. . . . Succeeding **G. F. Naumann,** who retired because of ill health, **C. E. Weir** is the new manager of the Edwardsville, Ill., plant of **United States Radiator Corp.,** Detroit. He had been assistant manager of the firm's Geneva, N. Y., plant.

In line with its plans for expanding commercial refrigeration activities, **Carrier Corp.,** Syracuse, N. Y., has promoted **David W. Hoppock** to product manager of commercial refrigeration. In recent months he has been assistant manager of self contained equipment. . . . The newly created post of sales manager of the parts sales and product service section, **General Electric Co.'s** air conditioning department, Bloomfield, N. J., is being filled by **John L. Roth.** He is responsible for the sale of commercial refrigeration condensing units of 5 hp and under to

JOHN ZINK

Whisper Quiet Model

UNIT HEATERS

Two Popular Models Available

WHISPER QUIET MODEL—For installations requiring quiet operation. More Head Room —Compact Design and More Heat From Gas Burned. A. G. A. approved for natural, manufactured, mixed or LP gases. Fully equipped with Automatic Controls.

HURRICANE MODEL—For Industrial Installations. This model is also compact in design, offering more Head Room and More Heat from Gas Burned. Will heat 40′ x 80′ space. A. G. A. approved for natural, manufactured, mixed or LP gases. Automatic Controls.

100,000 Btu/hr.

Both Models finished in Toast Tan Crinkle Enamel Baked on. Adjustable Louvers.

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CENTRAL HEATING PLANT

Can Be Installed In Attic Basement or Closet

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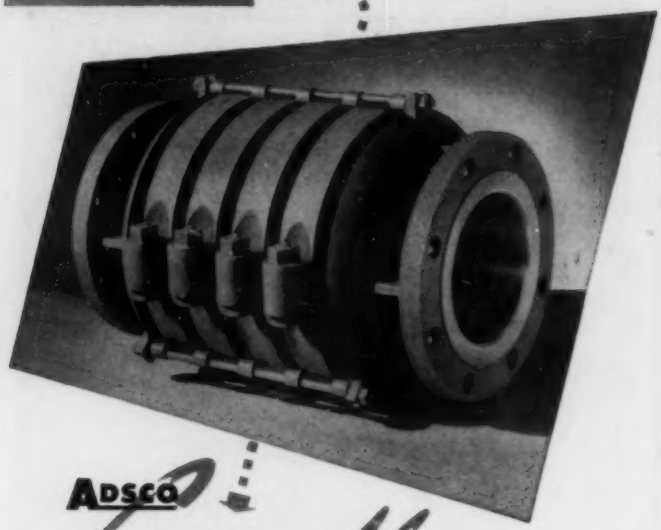

ADSCO Corruflex
PACKLESS EXPANSION JOINTS

Corruflex, ADSCO's new packless corrugated expansion joint, rounds out the most complete line of expansion joints available from any manufacturer. Only ADSCO can make both an expert analysis of your expansion problem *and* an impartial recommendation of the type of joint to use.

Corruflex, because it is packless, is ideally suited for remote and difficult-to-service installations.

Corruflex is economical because it makes expensive pipe bends unnecessary.

Corruflex is available in sizes from 3" to 24", single or double units, single or multiple corrugations, with or without self-equalizing rings and with flanged or welding ends. It is supplied in copper, stainless steel or other alloys and with internal sleeves if required.

Corruflex has a traverse range from fractions of an inch to 15" and will operate under pressures from vacuum to 300 lbs. and temperatures from sub-zero to 1600° F.

For further details, consult your ADSCO representative or write for Folder No. H-149.

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N. Y.
SINCE 1877

distributors and to recently appointed parts depots, and for the sale of all renewal parts. The company has recently set up over 50 such parts depots throughout the country. One of the latest appointments is that of **Joseph Simons Co.,** Sheldon and Union Sts., Hartford, Conn. The firm will stock repair and replacement parts of all General Electric condensing units, as well as sealed condensing units for replacement purposes, and will handle the sale of condensing units up to and including 10 hp. The territory to be served includes Maine, Connecticut, Vermont, and parts of Massachusetts.

Two veteran employees of **Johnson Service Co.,** Milwaukee, have been promoted. **Paul D. Gayman,** manager of the Cleveland branch since 1938, is now manager of the western district with headquarters in Milwaukee. Succeeding him is **Parker D. Shepperd** who has been senior sales engineer in Detroit. The western district had been under the immediate direction of J. A. Cutler, president and general manager. . . . **Hobart C. Ramsey,** president of **Worthington Pump and Machinery Corp.,** Harrison, N. J., recently participated in special ceremonies commemorating the 400th anniversary of Newark-on-Trent, England. In a two way radio broadcast he congratulated the directors of the company's British associate, **Worthington-Simpson, Ltd.,** on the important role the organization has played in its community.

Robert J. Mullally, district sales manager in charge of the Detroit office for **Youngstown Sheet and Tube Co.,** Youngstown, Ohio, has retired after 29 years with the company. He is succeeded by his former assistant, **C. Hix Jones.** The company's New Orleans office is in charge of **D. L. Markle, Jr.,** district sales manager, who was transferred to that branch as a salesman from Dallas this year. He succeeds the late **Orville B. Ewing.** . . . **Combustion Engineering-Superheater Inc.,** New York City, has named **H. D. Nickle** manager of the new district office for the northwest territory including the states of Washington and Oregon. He will be located in the Skinner Bldg., Seattle. Since 1945, Mr. Nickle has been in the New York office in charge of paper mill division sales.

Formerly sales representative in the Milwaukee district office of **Allis-Chalmers Mfg. Co.,** Milwaukee, **Harold L. Gruehn** is the new midwest region dealer supervisor with headquarters in Chicago. He has been with the firm since 1941 and since 1945 has been specializing in paper mill industry and franchise products. . . . The new dust control representative in Memphis and vicinity for **American Air Filter Co., Inc.,** Louisville, Ky., is **Industrial Sales and Engineering Co.,** operated by **C. W. Dean,** who has been product manager and chief engineer, Buckman Laboratories, Inc. . . . **Grant E. Scott, Jr.,** is now assistant sales manager of **Klipfel Valves Inc., Div. of Hamilton-Thomas Corp.,** Hamilton, Ohio. He was previously with Wright Aeronautical Corp. as test engineer and with Allis-Chalmers Mfg. Co. as field and sales engineer.

F. E. Schuchman, newly elected president of **Homestead Valve Mfg. Co.,** Coraopolis, Pa., also holds the title of general manager and treasurer. **W. R. Schuchman,** another son of the founder, has been named chairman of the board after 28 years as president, and **J. E. Roth,** former board chairman, is now chairman of the advisory committee. Other officers named are **Bradley McCormick,**

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secretary, and **N. E. Kolesar,** assistant treasurer. . . . **Turner Construction Co.,** has elected **Edward X. Tuttle** as vice president in charge of new business with supervision of contract negotiations in its four offices in New York, Boston, Chicago, and Philadelphia. With headquarters in New York, he succeeds **J. P. H. Perry** who continues as vice president and consultant on new business.

As a continuation of its distributor franchising program, **Perfex Corp,** Milwaukee, has appointed 13 new distributors. Serving the west are **R. M. Brand Co.,** in Tucson, Albuquerque, and part of Texas; **Leekley-Hergenrather & Assoc.,** Los Angeles, which will handle southern California; and **R. A. Parker Co.,** San Francisco, covering northern California and Nevada. Middle west appointments include **Thermatic Corp.,** Chicago, handling northern counties of Illinois and Indiana; **Regulator Controls Co.,** Indianapolis, operating in the southern two-thirds of Indiana; **Charles D. Jones Co.,** Kansas City, Mo., for Kansas and the western half of Missouri; **Prawl Engineering Corp.,** Omaha, serving the western part of Iowa and the state of Nebraska; and **Ohio Pump Service Co.,** Cleveland, handling the northeastern Ohio territory. Distributors and territories in the east are: **Harco Distributors, Inc.,** Baltimore—western Maryland and the northern tip of Virginia; **Patterson Service Sales Co.,** New York City—New York metropolitan traders' area; **Thermotrol Corp.,** Philadelphia—southern New Jersey, Delaware, the eastern shore of Maryland, and southeastern Pennsylvania; and **C. B. Soper Co.,** Boston—the eastern half of Connecticut and the balance of New England. In the south, **Chet Adams Co.,** Greensboro, will handle North and South Carolina and most of Virginia.

Kennard Corp., St. Louis, has added a number of men to its staff of engineering field representatives. Recent appointments include **Chet Adams Co.,** Greensboro, N. C., **John J. Barry,** Baltimore, **M. Balzer & Son,** Passaic, N. J., **John R. Ellstrom,** Philadelphia, **Don E. Hawk Associates,** New York City, **Paller Engineering Co.,** Indianapolis, **J. Fuller Stafford** and **C. L. Benson Associates,** St. Paul, Minn., and **R. F. Zimmerman & Co.,** Shreveport, La. . . . **William N. Pauley,** formerly with Farr Co., has joined **Marshall, Neil & Pauley, Inc.,** Houston, Tex., sales engineers and distributors of mechanical equipment. The firm represents Farr Co. in the greater part of Texas.

Distributor coverage in the state of New Hampshire for the line of "Freon" products of **Baker Refrigeration Corp.,** South Windham, Me., is being handled by **H. E. Humphreys Co.,** Concord. . . . **Wolverine Tube Div., Calumet and Hecla Consolidated Copper Co.,** Detroit, has opened a new southeastern district sales office in Atlanta, Ga. Located at 788 Spring St., N. W., **A. R. Kaspark** is in charge and will cover north and central Georgia, eastern Tennessee, and western counties of North and South Carolina. . . . **Franklin A. Ulrich** is now controller of **Fedders-Quigan Corp.,** Buffalo, **William C. Winkler,** treasurer and director, having relinquished the duties of controller to devote himself to the responsibilities of treasurer. . . . **Robert S. Daley** has recently been stationed in the Seattle sales headquarters of **National Radiator Co.,** Johnstown, Pa.

Aerofin heat-transfer surface is available in a complete range of sizes, designs and materials for heating and cooling application. Write for information.

ACCURACY • EFFICIENCY • DEPENDABILITY

AEROFIN

Fin-Type Heat Exchangers

You get all three — accuracy, efficiency and dependability — when you install Aerofin heat-transfer surface. Continuous research has led to the development of extremely accurate ratings — you can install to full capacity with complete confidence. And Aerofin's unequalled experience and facilities in the exclusive manufacture of fin-type surface for 26 years assure you of dependability and maximum efficiency.

Aerofin staff engineers are well qualified and quickly available to assist you.

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ASCO SOLENOID VALVES

It's "Factory Mutual Approved," meaning that it has passed very rigid tests as to tight seating and reliability of operation!

This ASCO Safety Shut-off Valve is designed to protect personnel and apparatus heated by gas for it provides a sure automatic cut-off of the flow of gas to the burner should something go wrong necessitating instant shut-down. On failure of energizing current it closes instantly and remains closed until the current is restored *and* it is opened manually. The safety function is automatic; restoration to service is manual!

If you are operating or designing gas burners or gas-fired equipment, you will be interested in the full details of ASCO "Factory Mutual Approved" Safety Shut-off Solenoid Valves. Write us. If you are interested in other automatic flow control of gas or liquids, we have many other types of solenoid valves.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

Automatic Switch Co.

389 LAKESIDE AVENUE · ORANGE, NEW JERSEY

Nominations of the **American Gas Association's** general nominating committee for the 1949-50 fiscal year include **Hugh H. Cuthrell,** vice president, Brooklyn Union Gas Co., for president; **D. A. Hulcy,** president, Lone Star Gas Co., Dallas, for first vice president; **George F. Mitchell,** president, Peoples Gas Light & Coke Co., Chicago, for second vice president; **Edward F. Barrett,** president, Long Island Lighting Co., for re-election as treasurer. . . . Closing its 1948-49 competition of annual engineering undergraduate award and scholarship fund, **James F. Lincoln Arc Welding Foundation** has presented awards and scholarships totaling $6750. Funds for scholarships totaling $1000 were awarded to the **University of Wisconsin,** $500 to **Case Institute of Technology,** and $250 to **Iowa State College.** In addition, awards were made to 47 students in engineering schools for excellence of their papers submitted on arc welding design, fabrication, maintenance, and research. Besides these main awards, smaller awards were made to 77 undergraduates.

National Air Conditioning Inc., Johnstown, Pa., has named **Eckstein Co.,** 526 Galveston Ave., Pittsburgh, wholesale distributor in western Pennsylvania, Ohio, and West Virginia. The company also handles the heating equipment of **National Radiator Co.,** of which National Air Conditioning is a division. . . . **Maurice H. Thomas,** formerly with Plumbing Supply Co., has joined the sales staff of **L. J. Mueller Furnace Co.,** Milwaukee. He will cover parts of Indiana, Ohio, West Virginia, and Kentucky. . . . **Wm. G. Boales & Associates,** manufacturers' agents of Detroit, have moved to their new building at 1150 W. Baltimore Ave.

Additions to the executive personnel of **Pesco Products Div., Borg-Warner Corp.,** Chicago, include the naming of **John A. Lauck** as vice president. He has been chief engineer of the pump division for the last four years. **D. A. Sutherland,** formerly eastern sales manager for industrial products, is now industrial relations manager, **G. V. Patrick,** former executive vice president of Cleveland Automatic Machine Co., succeeds Mr. Sutherland, and **Frank R. Canney** is sales engineer in charge of activities with airline companies. Pesco's entire manufacturing and research equipment is to be moved to the new 35 acre site in Bedford Township near Cleveland. . . . In his new capacity as manager of the **Combustioneer Div., Steel Products Engineering Co.,** Springfield, Ohio, **Georges Roudanez** will direct activities in the sale and distribution of the company's automatic coal stokers and humidifiers. He has over 20 years' experience in the stoker industry and was formerly industrial sales manager for Harry Ferguson, Inc.

Clyde S. Meyers, manager of industrial relations for Weber Showcase and Fixture Co., has been elected president of the **Refrigeration Manufacturers Association of Southern California, Inc.** He will serve until the middle of next year and succeeds **B. R. Glazer** of the Super-Cold Corp. Other officers who will serve with him are **Rex L. Loop,** Ward Refrigeration and Mfg. Co., vice president, and **Berger H. Bakke,** Coldew Corp., secretary-treasurer. . . . Two new sales engineers for **Edward Valves, Inc., Subsidiary of Rockwell Mfg. Co.,** East Chicago, Ind., are **Thomas J. Williams** of Houston, Tex., serving the southwestern states and **Herbert J. Rowe,** St.

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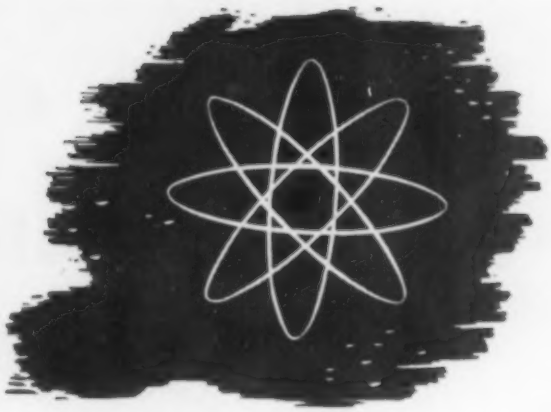
Louis, covering the Great Lakes region. Headquarters for these men will be Tulsa and East Chicago respectively.

The new manager of the product engineering department, **Building Products Div., Great Lakes Carbon Corp.,** New York City, is **Harry E. Lewis.** He has had over 16 years of experience in the field of insulation, heating, and refrigeration. . . . **D. F. Bennett,** manager of radiation and unit heater sales, **Warren Webster & Co.,** Camden, N. J., appeared as a recent guest on a popular Philadelphia radio show. He was interviewed on the subject of baseboard heating. . . . **Boiler Equipment Service Co.,** 686 Greenwood Ave., N. E., Atlanta 6, sales and engineering representative for **Cochrane Corp.,** Philadelphia, in the Florida and Georgia territory for industrial water treating equipment and steam specialties, has also been appointed representative for the company in the state of Alabama, less Mobile and Baldwin counties which are handled by **Allen J. Harris Co.** from New Orleans.

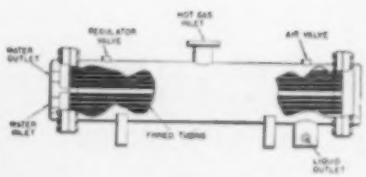
Lee S. Whitson, chief industrial engineer, **Minnesota Mining and Mfg. Co.,** St. Paul, has been appointed professor of mechanical engineering at the University of Minnesota. A graduate of the university and a former staff member, he will be in charge of the section of industrial engineering in the Institute of Technology. . . . **John Q. Predale,** assistant project engineer for Arma Corp., has been named assistant professor of mechanical engineering at **Illinois Institute of Technology.** He received his master's degree in mechanical engineering last June from Stevens Institute of Technology. . . . **J. W. Worthington,** 401 N. Broad St., Philadelphia, has represented **Schaible Co.,** Cincinnati, for the past eight years. He is now also representing the firm's **D. T. Williams Valve Co.** division.

Newly elected officers of the **Stoker Manufacturers Association,** Chicago, are: president—**Claude A. Potts,** U. S. Machine Corp.; vice president—**C. T. Burg,** Iron Fireman Mfg. Co.; secretary-treasurer—**C. P. Meredith,** Steel Products Engineering Co.; and executive secretary —**Marc G. Bluth** (appointive). . . . **Lynch Corp.'s Par Compressor Division,** Toledo, has named **R. C. Warneke** chief refrigeration and air compressor engineer for the Defiance, Ohio, plant. He was formerly connected with General Electric Co. for nearly 20 years. . . . **Meters & Controls, Inc.,** 236 N. Clark St., Chicago, is now representing **J. E. Lonergan Co.,** Philadelphia, in the Chicago area.

Harry L. Quinn is the new sales manager of the air conditioning division, **Refrigeration Engineering, Inc.,** Los Angeles. His experience covers a wide association in the sale of both commercial refrigeration and air conditioning equipment. . . . **L. J. Krause Co.,** recently formed Minneapolis organization, is representing **Krueger Sentry Gauge Co.,** Green Bay, Wis., in Minnesota, North and South Dakota, eastern Iowa, and western Wisconsin. . . . The election of **T. W. Simmons, Jr.,** as vice president and general manager and the appointment of **Kenneth G. Lundie** as general sales manager of **Johnston Pump Co.,** Los Angeles, have recently been announced. Until recently, Mr. Simmons was president of Johnston Aquamatic Co. of York, Pa. Mr. Lundie has been connected with sales in the turbine pump business for over 25 years.

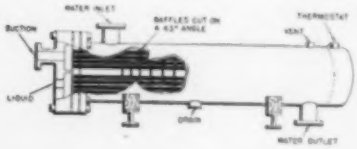


Electronic tube expanding for Patterson *freon coolers and condensers*



Patterson freon condenser
type O fin tube construction

Electronic Engineering has found the way to provide automatic, regulated control when expanding tubes in the tube sheet. The operator sets the electronic control at a predetermined point, selected for the kind of metal used and size of tube to be expanded. Just the right pressure and timing—automatically.



Patterson freon cooler
dry expansion type

Electronic tube expanding eliminates the chances of human error . . . chances of either overexpanding, resulting in overstressed metal or underexpanding, resulting in probabilities of early leakage and high maintenance.

In our shop, all tube expanding operations are carried on under Precision Electronic Control. Metal to metal joints are tight, strong, and safe . . . a plus value to be found in all Patterson-Kelley Freon Coolers, Condensers, Heat Exchangers and other tubular products.

The **Patterson-Kelley Co., Inc.**

86 Burson St., East Stroudsburg, Pa.

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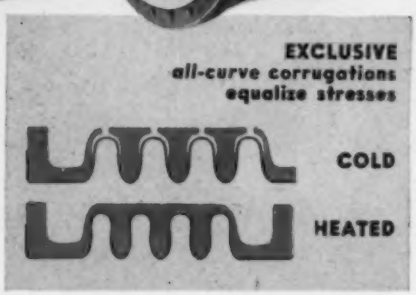
ANOTHER REASON WHY

Badger

IS FIRST IN

expansion joints



Because the flexing member is made from a single tube, Badger Expansion Joints are installed without packings. This feature alone means valuable savings in man hours . . . assures long service without attention.

And that's only *one* reason why you get top performance — *at lowest cost* — from Badger Corrugated Expansion Joints. Here are others:

- Flexible . . . joints easily compress and expand reducing thrust on adjacent fittings and equipment
- Compact . . . require no more space than regular flanged fittings
- Special forming methods . . . no danger of structure-weakening stresses
- Controlled heat treating . . . to assure long life for flexing member
- Directed flexing rings . . . to equalize stresses *between* and *within* corrugations

These features are important in any pipe line job — you can get them *all* only by specifying Badger Expansion Joints.

Write today for Bulletin 100 (self-equalizing type) or Bulletin 200 (non-equalizing type).

Badger

MANUFACTURING COMPANY

260 BENT ST. CAMBRIDGE 41, MASS.

R. J. Clark, as head of the R. J. Clark Equipment Co., Inc., Clearwater, Fla., is handling representation of **Nu-Way Corp.,** Rock Island, Ill., in Florida and southern Georgia. . . . **Automatic Control Co.,** St. Paul Minn., has named **J. F. Wulfetange, Jr.,** 317 State St., Syracuse 2, as eastern New York representative. . . . **Jack Dowd,** former territory manager of Silex Co. and well known in the small appliance field, has joined **Cory Corp.,** Chicago, and has taken charge of its Kansas City territory. He has succeeded **Harry Roehm** who has been advanced to head a newly formed southwestern district office. . . . **Natkin & Co.,** Kansas City, Mo., has opened a sales office in New York City for the purpose of contacting chain stores and industries where purchasing is done in the east for installation in the midwestern portion of the country. The office is under the direct management of **Bert Natkin,** vice president.

The new direct sales representative of **Allin Mfg. Co.,** Chicago, for the states of Wisconsin, Illinois, Indiana, and parts of Minnesota and Kentucky is **Rollin H. Lacart.** He was formerly with Electrimatic Div., Simoniz Co. . . . **Gordon F. Walker, Milwaukee Gas Specialty Co.,** Milwaukee, has been assigned the eastern sales territory and will make his headquarters in Philadelphia. He will cover the New England states, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, and North and South Carolina. He was formerly engaged in developmental work for the company. . . . **Motorstoker Div., Hershey Machine and Foundry Co.,** Manheim, Pa., has appointed **Richard A. Haggerty** general sales manager. He was formerly president of Automatic Coal Burner Co. All present members of Motorstoker remain in their former capacities.

Three executives have been named for the **D. T. Williams Valve Co., Division of Schaible Co.,** Cincinnati. **Albert H. Weddendorf, Jr.,** is vice president and general manager. **Charles G. Wirtz** is plant superintendent, and **Herbert D. Hinson** is chief engineer. **A. E. Judd Co.,** 2716 N. Broadway, Los Angeles, which has represented Schaible for the last 10 years, is now also representing the Williams division in southern California and Nevada, the states of New Mexico and Arizona, and a portion of Texas in the vicinity of El Paso. . . . Two new representatives for **Radiator Specialty Co.,** Charlotte, N. C., are **Ralph L. Sebrell,** Cleveland, who will cover Ohio and eastern Indiana, and **Roy E. Paige,** New York City, who will handle the territory of greater New York, Long Island, and the northern part of New Jersey.

Vapor Heating Corp., Chicago, has appointed **Dana Pierce** to handle sales of temperature controls to the aircraft industry on the west coast. He will work out of the corporation's office in Los Angeles. . . . **Herbert S. Leo** has taken over the newly created position of director of sales, heating appliances division, **Utility Appliance Corp.,** Los Angeles. He has been chief engineer for the past seven years and is succeeded by **Richard J. Peterson,** former research and development supervisor. . . . **Sidney Sussman,** Ph.D., has become associated with **Water Service Laboratories, Inc.,** New York, as chief chemist. For the last three years he was chief chemist for Liquid Conditioning Corp.

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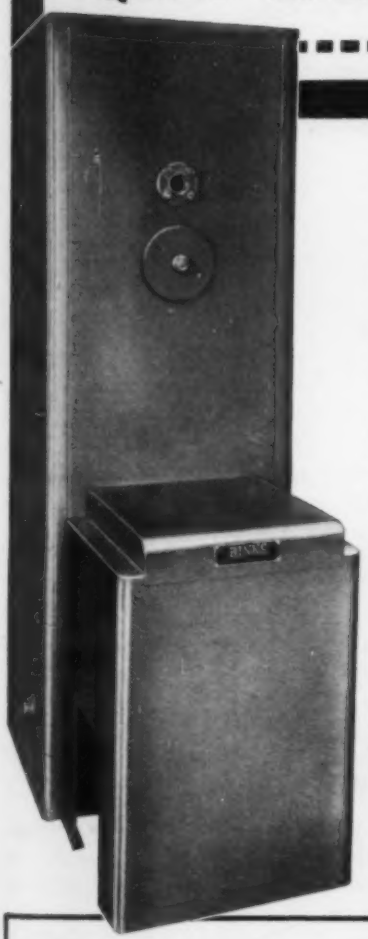
BINKS Type "B"
Forced Draft Cooling Towers give you maximum cooling efficiency
plus
QUIET OPERATION



Special slow speed, quiet operating blower assembly on Binks Type "B" Cooling Towers eliminates noise, making them ideal units for clubs, hotels, restaurants, homes or any inside installations. Also suitable for a wide variety of industrial processes where heat is liberated to circulating water. Cut water cooling costs to almost nothing . . . you can use the same circulating water over and over. Patented design of these towers greatly increases air-to-water ratio without increasing power consumption. The result is greater efficiency and less wear. Highly efficient where natural air movement is restricted . . . they create their own draft. Available in 34 standard sizes.

Binks

Send now for Bulletin No. 35, describing Binks type "B" Forced Draft Cooling Tower in full. State tower capacity required.

THERE'S A BINKS TOWER FOR EVERY COOLING JOB

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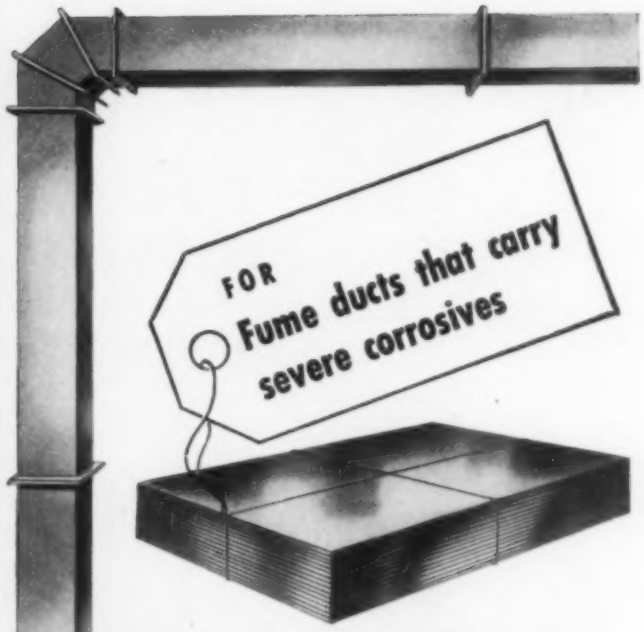

THE NEW DURIMET 20, ANTI-CORROSION SHEET AND PLATE

As Easy To Fabricate As Ordinary Stainless

To give the fume hoods and ducts in your chemical laboratory lasting corrosion-resistance make them of the new Durimet 20 sheet.

This newly developed form of Durimet 20 can withstand really tough corrosives. Its resistance is far better than ordinary stainless steels or even previous analyses of Durimet.

This corrosion resistance is as permanent, uniform and thick as the sheet itself. There is no lining to chip, crack or spall and leave the duct vulnerable. A Durimet 20 duct encloses laboratory fumes with a solid wall of corrosion-resistance.

This special stainless steel can be easily fabricated by methods familiar to ventilating contractors experienced in handling 18-8 stainless. It forms a light, strong, lasting fume passageway. Use it for laboratory table tops, sinks and troughs, too.

Write for Bulletin 502.

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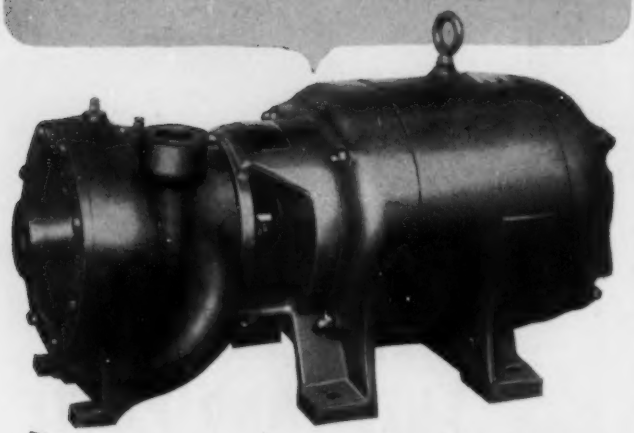
CORROSION RESISTING ALLOYS & EQUIPMENT

EFFICIENCY! ECONOMY! ADAPTABILITY!

for DEPENDABLE CIRCULATION of BRINE AND CHILLED WATER!



Type GG Two Stage Unipump with 15 H.P. motor.

OPERATES EFFICIENTLY IN ANY POSITION

WEINMAN Centrifugal UNIPUMPS

CAPACITIES 10 TO 1000 G.P.M.

UNIPUMPS are engineered by WEINMAN CENTRIFUGAL SPECIALISTS to meet the need for a highly efficient, quiet and leakless BRINE AND CHILLED WATER CIRCULATOR . . . at a reasonable price!

They will operate efficiently regardless of the angle of installation on floor or wall . . . require minimum space . . . and are easy to install.

Built in sizes to provide capacities of 10 GPM to 1000 GPM . . . heads to 500 feet . . . and motor ratings from ⅓ hp to 30 hp.

WEINMAN CENTRIFUGAL SPECIALISTS are at your service . . . To Give Service . . . got a problem? . . . phone, wire or write.

Bulletin 726-C2 sent upon request.

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NEW BOOKS & REPORTS

Studies Stresses on Piping Expansion Bellows

As a result of failures of stainless steel bellows used to take up thermal expansion in the piping of petroleum and chemical processing equipment, F. J. Feely, Jr., and W. M. Goryl, both of the Esso engineering department, Standard Oil Development Co., undertook a study of problems involved. Their results are contained in the paper Stress Studies on Piping Expansion Bellows.

The authors deal with high temperature, low pressure type expansion joints constructed by crimping thin stainless steel discs into shallow cones which are resistance welded together at their inner and outer edges. A basis is presented for designing bellows within reasonable stresses. A formula is derived to show the total stress induced in the material as a result of the combined effects of pressure and movement. The validity of the approximations used in the formula has been verified by laboratory strain gage measurements. A relationship between several variables has also been determined and serves as a basis for dimensioning the discs to achieve the most economical proportions. Several supplementary formulas are also given for finding bellows characteristics which may affect the design of adjacent piping. Problems in connection with high pressure service are discussed briefly and some preliminary laboratory data are presented on a commercial joint.

The authors conclude that strains due to movements of as little as 0.2 in. far exceeded strains due to internal pressure of 250 psig and that strains due to deflection at 25 psig showed no significant difference from those at 250 psig so long as the movement was the same. Contrary to results predicted from equations based upon beam theory, it was found that maximum stresses were circumferential in direction rather than radial, and these occurred in the center portions of the torus sections rather than near the inner or outer welds.

The paper was presented at the recent national meeting of the applied mechanics division, American Society of Mechanical Engineers, 29 W. 39th St., New York 18. It is identified as Paper No. 49-APM-22.

Water Must Be Treated to Control Condenser Fouling

When water is used as a coolant in a heat exchanger, fouling may become acute in a relatively short time. While this may conceivably be due to poor design, effective water treatment to control scale, corrosion, and organic growth can never be divorced from the need for a well engineered design, according to Ralph M. Westcott, partner in the firm of Montgomery & Pomeroy, consulting chemical engineers.

His paper, Control of Condenser Fouling by Water Treatment, was prepared to "assist anyone interested in the problem to follow an intelligent course of action." Specific methods for any given problem have been intentionally avoided as local water conditions cover such a wide range of variations that any rule of thumb methods could easily be misinterpreted. Nevertheless, the article provides a good deal of general information which should be of interest to anyone responsible for the operation of water cooled heat transfer equipment.

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*Airsan** Air Filter Protection Means Effective Dust Collection

Airsan expanded metal face plate acts as a lint arrestor to provide easier cleaning and servicing and distributes air evenly over entire filtering area, providing high filtering efficiency and dust holding capacity with low resistance. Other features include all galvanized construction and full bronze welded corners.

Airsan Air Filters available in standard 1" and 2" thickness with filters for industrial and special applications in 2" and 4" thickness.

Holding frames (for V type or straight banks) are made for all type filters.

* FORMERLY AIRCOR

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108F NO. WATER ST. • MILWAUKEE, WIS.

Canadian Representative
DOUGLAS ENGINEERING CO., LTD., MONTREAL

YOUR BEST BUY IS BY Bendix AVIATION CORPORATION

VIBRATION ELIMINATORS

Wherever you are faced with the problem of piping refrigerant gases and liquids under varying degrees of temperature and vibration, Bendix Seamless Flexible Metal Hose is the perfect answer. Deep parallel corrugations, uniform wall thickness and seamless construction assure greater flexibility—longer service life.

Engineered to your requirements.

Rubber covered where desired.

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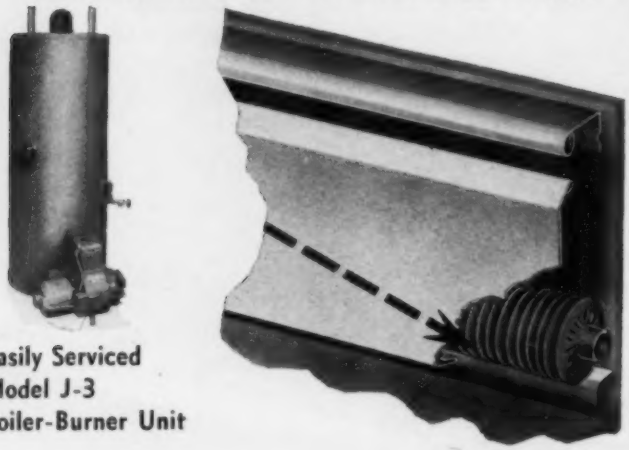
GENERAL AUTOMATIC "FLOORLEVEL"

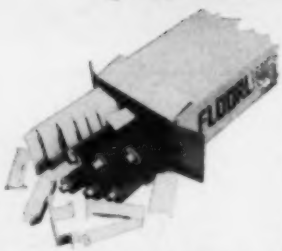
BASEBOARD HOT WATER HEATING



Easily Serviced
Model J-3
Boiler-Burner Unit

No Radiators!

Heating elements concealed in metal baseboard.



Easy to Store!

No extra warehouse space needed for extra spare parts.

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Demonstration Model makes selling easy.

Write, wire or phone us for complete details, prices and franchise rights.

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Fin Type Copper Heating Element
Front Panel
Front Panel Splice
Wall Bracket
Front Panel Inside and Outside Miter Corners
End Terminals
Top Moulding
Top Moulding Inside and Outside Miter Corners
End Terminals
Top Moulding Splice Piece

5 SIZES

#60 for 200 sq. ft. of Radiation
#70 for 233 sq. ft. of Radiation
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#90 for 300 sq. ft. of Radiation
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GENERAL Automatic

CONVERSION BURNERS
WARM AIR CONDITIONERS
BOILER BURNER UNITS
WATER HEATERS

GENERAL OIL BURNER CORPORATION
2300 Sinclair Lane, Baltimore 13, Md.

After mentioning the influence of design, Mr. Westcott defines and describes the different types of fouling and then briefly covers controlling concentrations in a recirculating system, water velocity and distribution, water qualities, physical maintenance, and types and methods of treatment. It is pointed out that there are various chemicals available for treatment and each requires different handling methods and concentrations. Each problem, he says, requires individual analysis.

The paper is available in the form of an eight page data sheet (No. 46) from the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18, for 40 cents.

Explains How Gas Pressure Pulsations Induce Mechanical Vibration in Piping

Some of the pulsation energy in gases, resulting from reciprocating compressors, is converted to periodic physical force because of the interaction between the gas and the pipe through which it flows. These periodic forces usually have a complex wave shape and often contain component frequencies which lie close or are resonant to the mechanically resonant frequencies of the pipe and/or associated structures. How this results in mechanical vibration is the subject of an article, Mechanical Vibration of Piping Induced by Gas Pressure Pulsations, by Raymond C. Baird, research engineer, and Ira C. Bechtold, director of research and development, Fluor Corp., Ltd.

The generation and nature of gas pressure pulses from reciprocating compressor action is described and means whereby pulse energy is converted into vibration are discussed by the aid of analogous mechanical, acoustical, and electrical oscillatory systems. It is shown that vibrational stresses are a function of the square of the frequency as compared with the first power of the amplitude. Phasing, as when two or more compressors are connected to the same discharge header, is discussed at some length. It should be noted however that the authors do not attempt in this paper to show how vibration can be minimized or eliminated, though the economic importance of this is indicated.

The paper was contributed by the petroleum division of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, and was presented at its recent semi-annual meeting. It is designated Paper No. 49-SA-27.

Proper Firing Methods Necessary for Fuel Conservation, Smoke Elimination

Manual of Instructions on Proper Firing Methods in the Interest of Fuel Combustion and Conservation, Air Pollution, Smoke Abatement is the title of a booklet containing papers and data prepared by a number of well known authorities. Many of the papers have been previously published but the information will, nonetheless, be of interest to coal dealers and consumers. The material included consists of:

Teaching People to Burn Fuel Smokelessly and Economically, by Ben G. Elliott, professor of mechanical engineering, University of Wisconsin

The Ringelmann Chart, by Sumner B. Ely, superintendent, Pittsburgh Bureau of Smoke Prevention

Air Pollution Control as a Public Service, by D. A. Sullivan, public relations director, Smoke Prevention Association of America, Inc.

Instruments and Combustion Control for Small Steam Plants, by William H. Pugsley, vice president in charge of field research, Hays Corp.

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Technical Factors Affecting Steam Plant Performance, by E. D. Benton, director, division of research and fuel engineering, Ohio Coal Association

Achievements in Smoke Prevention, by Joseph T. Harrington, combustion engineer, Northern Illinois Coal Co.

Some Aspects of Incineration, by E. E. Smauder

How to Reduce Smoke From Hand Fired Furnaces, by J. R. Fellows, A. P. Kratz, and J. C. Miles, Engineering Experiment Station, University of Illinois

Fuel Conservation, by J. F. Barkley, chief, Division of Solid Fuels Utilization for War, Bureau of Mines

Charts for Determining Furnace Dimensions for Underfeed Stoker Installations

Directions for Hand Firing Coke

Paper bound copies of this mimeographed bulletin may be obtained from the Smoke Prevention Association of America, Inc., 139 N. Clark St., Chicago 2, for 50 cents.

Other Books and Reports Received

List of American Standards (July 1949)—The mid-year listing of the American Standards Association includes more than 140 new standards approved since the first of the year and contains a total of 1124 specifications, methods of test, building requirements, dimensions, safety codes, definitions, and terminology in all fields of engineering. The 28 page list may be obtained from association headquarters, 70 E. 45th St., New York 17, at no charge.

16th Annual Report of the Engineers' Council for Professional Development—Features several reports indicating progress made last year by ECPD committees to enhance the professional status of the engineer. Reports deal with student selection and guidance, engineering schools, professional training, and professional recognition. Council headquarters is at 29 W. 39th St., New York 18.

Boiler Reference Book—Dr. Oscar H. Pape, author of the Pape-Swift books, has compiled a new edition which not only contains the previous editions (1933-1939) but also new data to December 1948. Containing 960 pages, 8½ x 11 in., it gives boiler data on equipment of approximately 125 manufacturers. Only one book is published but supplements will be issued each year. The price is $12.00 with supplemental subscriptions three years for $6.00.

Telling the Story of Research—Contains the proceedings of last year's winter meeting of the Engineering College Research Council of the American Society for Engineering Education. Contains remarks of seven well known editors and science writers on how to most effectively present, through the public press, the story of engineering methods, problems, and accomplishments. Copies may be obtained for 50 cents from the council's headquarters at the College of Engineering, State University of Iowa, Iowa City.

Industrial Hygiene Problems in Bolivia, Peru, and Chile (Public Health Bulletin No. 301)—Written by J. J. Bloomfield, sanitary engineer director and assistant chief, Division of Industrial Hygiene, U. S. Public Health Service, it contains a report of studies and recommendations made at the request of the governments of these countries under the auspices of the Institute of Inter-American Affairs. The report defines the problems and presents a definite program for their solution. Copies, at 40 cents, are for sale by the Superintendent of Documents, Washington, D. C.

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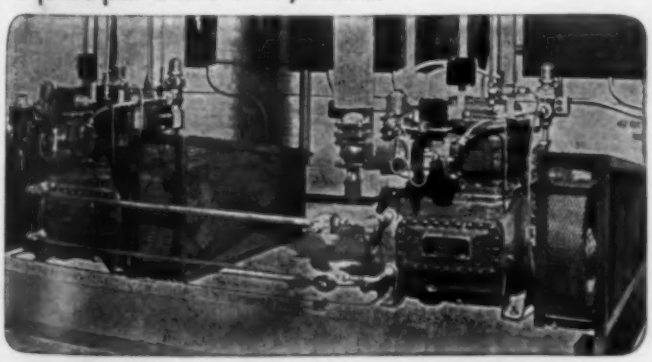

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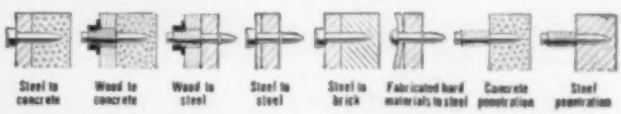

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MEETINGS & CONVENTIONS

Instrument Society of America, 921 Ridge Ave., Pittsburgh 12—The 4th annual conference and exhibit, September 12 to 16, Municipal Auditorium, St. Louis. A preconvention instrument maintenance clinic will be held September 9, 10, and 11 at the Statler hotel.

It is expected that over 12,000 persons will attend the exhibit and over 300 instrument men will participate in the clinic. The technical program of the convention will consist of 75 papers presented in 26 sessions. The ISA will have a total of 13 sessions; the National Telemetering Forum, four sessions; the American Institute of Physics, three sessions; the American Society of Mechanical Engineers, industrial instruments and regulators division, three sessions; the American Institute of Electrical Engineers, instruments and measurements committee, three sessions.

Corrosion Short Course—To be held September 12 to 16, University of Texas, Austin, and sponsored by the National Association of Corrosion Engineers, 919 Milam Bldg., Houston 2. The course, designed as a refresher in the fundamental phenomena with which the corrosion of metals is concerned, will consist of nine two hour lectures followed by discussion periods. Application for official registration blanks should be sent to A. B. Campbell, executive secretary of NACE. The registration fee is $20.00.

National Association of Corrosion Engineers, 919 Milam Bldg., Houston 2—South central regional meeting, Adolphus hotel, Dallas, Tex., October 3 and 4. Eight technical papers, a panel discussion, and various committee meetings are planned. Among the technical papers is one on selection of protective coatings for fume resistance by C. C. Harvey, Ethyl Corp. Another by W. H. Crenshaw, American Inspection Service, deals with internal corrosion of crude oil tanks, and Oliver Osborn, Dow Chemical Co., will discuss the combating of corrosion in chemical plants with magnesium anodes. Application of magnesium anodes to pipe line protection will be the subject of a paper by J. A. Holloway, Houston Pipe Line Co.

American Society for Testing Materials, 1916 Race St., Philadelphia 3—First Pacific area national meeting, Fairmont Hotel, San Francisco, October 10 to 14. Several technical committees will hold sessions and some 70 technical papers will be presented. Subjects to be dealt with include plasticity and fatigue of metals, dynamic stress determinations, high additive content oils, and turbine oils.

American Welding Society, 33 W. 39th St., New York 18—The 30th annual meeting and exposition will be held in Cleveland, the week of October 16.

As usual, the meeting will be held during the National Metal Congress and Exposition. The society has reserved a block of rooms at the Hotel Cleveland, headquarters for the meeting. Additional room applications will be referred to the Metal Congress Housing Bureau.

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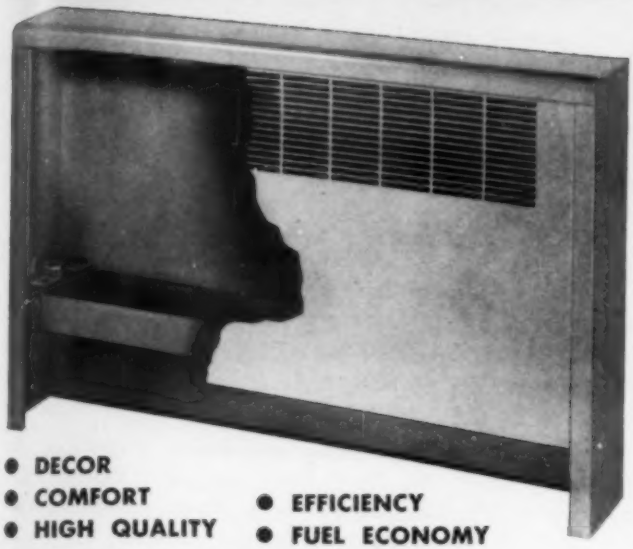

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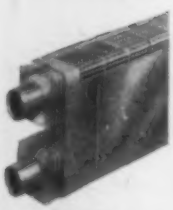

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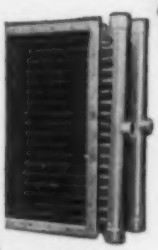

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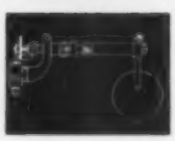

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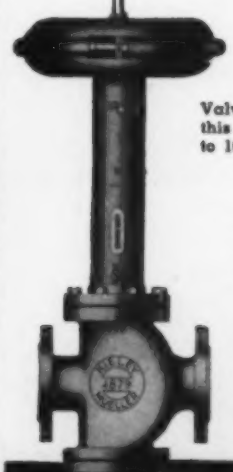

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The 37th National Safety Congress and Exposition, October 24 to 28, Chicago. Sessions on industrial safety are scheduled for the Stevens, Congress, and Morrison hotels. Further information can be obtained from R. L. Forney, general secretary, National Safety Council, 20 N. Wacker Dr., Chicago 6.

2nd Biennial Pacific Chemical Exposition, November 1 to 5, San Francisco Civic Auditorium—A display of natural resources of the 11 western states is to be a featured exhibit at the show which is sponsored by the California Section, American Chemical Society, Whitcomb hotel, San Francisco 1. Marcus W. Hinson is managing the affair.

During the affair, a number of one and two day conferences will be held by various organizations including the American Institute of Chemical Engineers, northern California section, the northern California rubber group, petroleum division, American Chemical Society, California section, and the Society of the Plastics Industry, San Francisco section.

Ninth Midwest Engineering and Power Exposition—November 11 to 16, Navy Pier, Chicago. George E. Pfisterer, 308 W. Washington St., Chicago, is managing director.

Sixth All-Industry Refrigeration and Air Conditioning Exposition, 1346 Connecticut Ave., Washington 6, D. C.—November 14 to 18, Atlantic City Auditorium sponsored by the Refrigeration Equipment Manufacturers Association. Over 5000 rooms have been pledged by nearby hotels and approximately 75,000 sq ft of exhibition space will be used. Headquarters for cooperating associations are: Traymore hotel, REMA and exhibitors; Claridge hotel, Refrigeration Equipment Wholesalers Association; Ambassador hotel, Refrigeration Service Engineers Society and Refrigeration and Air Conditioning Contractors Association; Chalfonte-Haddon Hall, Air Conditioning and Refrigerating Machinery Association and National Electrical Manufacturers Association.

The exposition will be open exclusively to service engineers and contractors on the first day, November 14.

American Society of Refrrigerating Engineers, 40 W. 40th St., New York 18—1949 annual meeting, December 5 to 7, Edgewater Beach hotel, Chicago.

Plant Maintenance Exposition and Conference, January 16 to 19, Cleveland Auditorium—Exhibits and conference subjects will deal with air conditioning, heating, ventilating, building supplies, electrical equipment, employee relations, instruments, lubricants, paints, materials handling, power generation and transmission, welding, etc. Advance registration cards may be obtained from Clapp & Poliak, Inc., 350 Fifth Ave., New York 1, exposition manager.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York 10—56th annual meeting, Dallas, Tex., January 23 to 26.

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Southwest Air Conditioning Exposition of the International Heating & Ventilating Exposition—State Fair Grounds, Dallas, Tex., January 23 to 27. As in past years, the show will be managed by International Exposition Co., Grand Central Palace, New York City, and will be held under the auspices of the American Society of Heating and Ventilating Engineers.

Heating, Piping, and Air Conditioning Contractors National Association, 1250 Avenue of the Americas, New York 20—1950 annual meeting, May 8 to 12, St. Francis hotel, San Francisco.

Plan for ASRE Winter Meeting

Chairmen of several of the committees appointed by the Chicago section of the American Society of Refrigerating Engineers to plan for the ASRE's national annual meeting to be held at the Edgewater Beach, Chicago, December 5 to 7, 1949, conferred last month on preliminary arrangements for the big affair.

Shown in the accompanying photo are, from left to right, K. E. Wolcott, treasurer of the Chicago section; J. E. Salmon, secretary of the committee; Leon Buehler, Jr., Chicago section chairman; Fred P. Neff, general chairman of the committee; H. J. Prebensen, chairman of the reception committee; Carl Eichstaedt, entertainment committee chairman; and Clarence Sieben, chairman of the banquet committee. Other committee chairmen include W. S. Bodinus, miscellaneous arrangements; D. E. Perham, meetings; J. P. McShane, budget; and C. M. Burnam, Jr., public relations. Mrs. J. P. McShane heads a committee planning activities for the ladies, and Burgess H. Jennings, national president of the ASRE and a member of the Chicago section, is honorary chairman of the general committee.

Gives Data on How to Eliminate Fly Ash From Small Boiler Plants

An eight page booklet, What Can the Small Plant Do About Fly Ash, by Carl E. Miller, technical advisor, Battelle Memorial Institute, provides a basis for judging the amount of fly ash the small plant emits with different types of firing equipment. Graphs are included to permit estimating the investment necessary to install a suitable collector and supplementary sketches show how collectors may be installed in plants under widely diversified space limitations.

Based upon research sponsored by Bituminous Coal Research, Inc., and still in progress, the material was originally presented at this year's Midwest Power Conference. Copies are available from BCR headquarters, 912 Oliver Bldg., Pittsburgh 22, for 25 cents.

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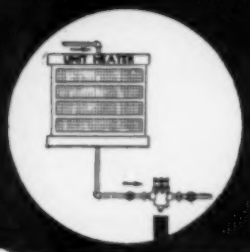
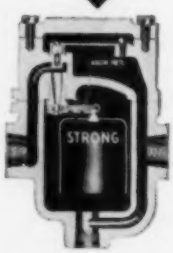


Accumulated condensate and trapped air can make unit heaters slow in starting. Uncertain drainage will seriously reduce heat output.



Strong 170-T trap with integral thermal air vent and new HI-CAP*Orifice. Available in sizes from ½" to 1".

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While *all* Strong Inverted Bucket Traps will handle large amounts of air, the hookups shown here provide thermal air vents for practically instantaneous heating. Use of Strong traps, guaranteed for a year against leakage, insures positive drainage without waste of steam.

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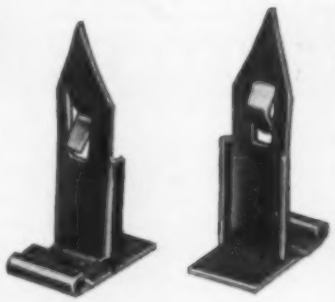

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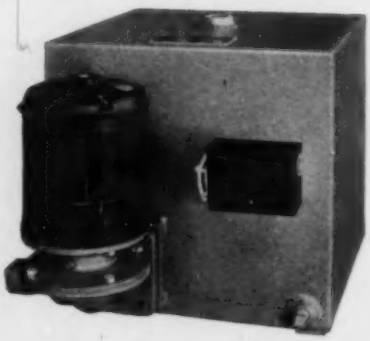
The 4100 Series is particularly attractive as a stock unit. Wide range of capacity and pressure ratings in one unit eliminates stocking number of pumps. Requires less than 2¾ sq. ft. of storage space, stacks conveniently.



Sterlco 4100 Series Condensation Pump with steel tank. ¼ H.P. capacity up to 6000 sq. ft. E.D.R. at 20 lbs. Also ½ H.P. unit for 8000 to 14000 sq. ft. at 20 lbs.

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RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 157. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

No. 7340: Air and Ammonia Compressors—Dimensions, specifications, and other details are given in two new bulletins released by Worthington Pump and Machinery Corp., Harrison, N.J. Bulletin H-620-B30 covers the company's line of electric driven, air cooled air compressors in sizes from ¼ to 15 hp and for pressures up to 250 psi. A section is devoted to dry vacuum pumps. Bulletin C-1100-B34 describes ammonia booster compressors of the v and w type, single acting, HA series. Four sizes range from 5 to 50 hp.

No. 7341: Air Diffusers—The Vol. 5, No. 2 issue of the house organ published by Anemostat Corp. of America, 10 E. 39th St., New York 16, leads off with a description of its new factory in Hartford, Conn., and tells how company products are made. An article describing the air conditioning system and the use of the firm's air diffusers in the new Poughkeepsie, N.Y. plant of International Business Machine Corp., starts out by defining the purpose and problems involved in comfort air conditioning in industrial buildings. A series of articles by F. F. Stevenson (May, June, July, and October 1948 issues of HPAC) is cited. The article also refers to HPAC's story of the IBM air conditioning installation (January 1949 issue). The booklet continues with articles dealing with the Whiting research laboratory of Standard Oil Co. (Indiana), a new method of installing the firm's diffusers, and part three in a series on fans.

No. 7342: Air Meter—Bulletin 25A of Anemostat Corp. of America, 10 E. 39th St., New York City, explains the operation and application of the "Anemotherm" air meter. In addition to covering the measurement of air velocity, the folder explains the application to temperature measurements ranging from 30 to 155 F and describes positive and negative static pressure work.

No. 7343: Arc Welder—The 170 amp, a-c unit of Birdsell Mfg. Co., Inc., P.O. Box 733, Los Altos, Calif., is described in a new single sheet bulletin. In addition to listing features, specifications, operator's instructions, and suggestions for obtaining good welds are given.

No. 7344: Care of Centrifugal Pumps—Handbook for Care of Centrifugal Pumps is the title of a newly revised booklet (08X6256A) published by Allis-Chalmers Mfg. Co., S. 70th St., Milwaukee. Besides giving the how and why of pump construction, the booklet tells how to figure head. Causes and cures of various sources of trouble are offered along with a new maintenance timetable. Other subjects covered include cavitation, the role of water as a lubricant, and common mistakes in packing stuffing boxes.

No. 7345: Cathodic Protection of Water Tanks—Cleveland Heater Co., 2310 Superior Ave., Cleveland 14, has published Educational Bulletin No. EB-104. The bulletin

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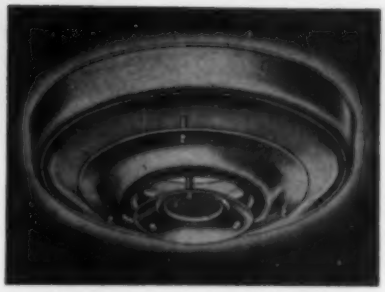

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is a paper by D. J. Fergus, company research engineer, on cathodic protection of galvanized hot water storage tanks by the use of galvanic magnesium alloy anodes. Data are presented on tests of zeolite softened Cleveland tap water with an average pH of 7.5 and distilled water with an average pH of 5.5. Copies of the bulletin may be obtained directly from the company for 25 cents to cover the cost of wrapping and mailing.

No. 7346: Condensation Pump and Receiver—The vertical type CV unit of Skidmore Corp., St. Joseph, Mich., is described in Bulletin No. 21. It is recommended for returning condensate to the boiler, or other points, from all types of low pressure steam heating systems and process equipment. Capacities range from 500 to 10,000 sq ft EDR.

No. 7347: Cooling Tower Selection—The Vol. 24, No. 2 issue of the house organ published by Foster Wheeler Corp., 165 Broadway, New York 6, contains an article giving data on an approximate method of selecting cooling towers and analyzing performance. The charts and other data contained are said to be particularly adaptable to mechanical draft, counterflow towers.

No. 7348: Corrosion Resistant Valves—The Vol. 8, No. 4 issue of the house organ published by Walworth Co. Inc., 60 E. 42nd St., New York 17, features an article on valves to combat corrosion. Units described include those made of monel, pure nickel, bronze, stainless steel, etc.

No. 7349: Diaphragm Control Valves, Liquid Level Controllers, and Regulating, Float, and Hand Control Valves — Belfield Valve Div., Minneapolis-Honeywell Regulator Co., Philadelphia 44, has issued a number of new catalogs. Each contains numerous charts and illustrations and gives detailed information on design and construction features, applications, dimensions, etc. Bulletin No. 10-1 covers regulating valves for steam, water, air, gas, or oil and also describes float or tank valves. Bulletin 700-1 is on diaphragm control valves, series 700. A section is devoted to pilot piston control valves. Bulletin No. 242-1 deals with "Hi-Lift" v port indicating type hand control valves, and Bulletin 48-1 describes both direct connected and air actuated liquid level controllers.

No. 7350: Direct Fired Air Heaters—Designed for either oil or gas firing, units in capacities from 1 to 100 million Btu per hr are described in Bulletin 600 of Peabody Engineering Corp., 580 Fifth Ave., New York 19. To clarify various applications, such as in catalytic cracking, spray drying, tunnel drying, preheating air, and compartment drying, colored flow charts and cross sectional drawings are used.

No. 7351: Electric Controls—The complete line of control devices of Ward Leonard Electric Co., Mount Vernon, N.Y., includes resistors, rheostats, relays, motor starters, contactors, accessories, and dimmers. They are described and illustrated in an eight page bulletin (No. 100,000).

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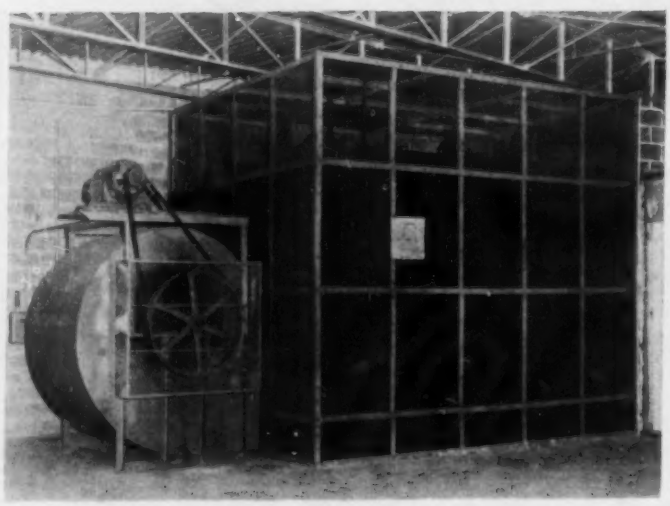

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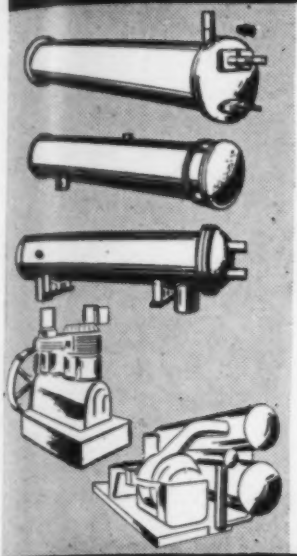

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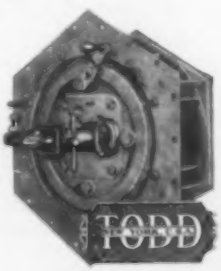

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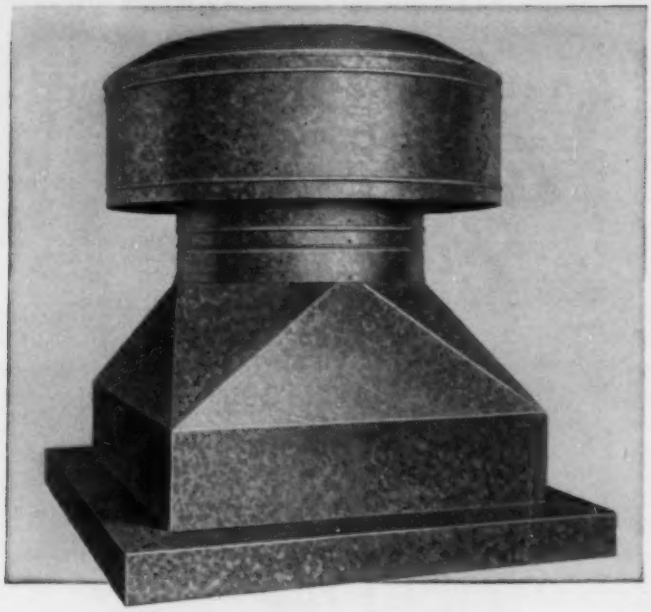

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No. 7352: Electric Motor with Variable Speed—A new 12 page bulletin (No. 611-D) prepared by Louis Allis Co., Milwaukee 7, describes a-c motors having infinitely adjustable speed. Called the "Ajusto-Spede," it is said to provide a variable speed output with a constant torque characteristic through an entirely new eddy current principle without the usual motor generator set or exciter.

No. 7353: Electric Wires and Cables for High Temperatures—Catalog 509 of National Electric Products Corp., Chamber of Commerce Bldg., Pittsburgh 19, covers "NEasbestus" wires and cables. These have asbestos or asbestos and varnished cambric insulation and are recommended for installation where extreme heat, corrosive fumes, and fire hazards are present. The wires described include 600 volt cable for motor connections and 600 volt control cable for boiler rooms and power stations.

No. 7354: Exhaust Fans—Bulletin X6259 of Emerson Electric Mfg. Co., St. Louis 21, Mo., covers both direct and belt driven propeller type exhaust fans for business, industrial, and institutional buildings. Information is also given on window and ventilating fans and recommendations for determining the proper size and method of installation are included.

No. 7355: Gearmotors—Catalog 1815-A of Link-Belt Co., 307 N. Michigan Ave., Chicago 1, embodies simplified catalog practice and replaces all previous booklets on the company's gearmotors. Double and triple reduction units of new design with the motor mounted concentrically in line with the output shaft are illustrated. Permissible overhung loads, dimensions, and other selection data are given.

No. 7356: Gearshift Drives and Electric Motors—Lima Electric Motor Co., Lima, Ohio, has issued Bulletin DB-1 covering gearshift drives for selective speed machine operation, electric motors, pedestal grinders, and buffing and polishing lathes. The combination four speed, sliding gear transmission and induction motor is featured.

No. 7357: Heat Resisting Paint—A new data sheet and application bulletin on "Heat-Rem" heat resisting aluminum paint has been released by Speco, Inc., 7308 Associate Ave., Cleveland 9. The paint is said to be suitable for use on all interior or exterior surfaces subject to temperatures of 1000 to 1500 F.

No. 7358: Hose Clamps—More than 160 different sizes and types make up the "Le-Hi" line of clamps which are designed to fit virtually every type of industrial and construction hose. Bulletin 125 of Hose Accessories Co., Lehigh Ave. at 17th St., Philadelphia 32, gives detailed information. Featured is a group of new undersize high pressure hose clamps of the interlocking type especially designed for the many new hose types with smaller outside diameters.

No. 7359: Hospital Heating and Conditioning Control Systems—Written for hospital supervisors and members of hospital boards, a new booklet describes, in nontechnical terms, heating and air conditioning requirements of different hospital rooms and areas. Prepared by Minne-

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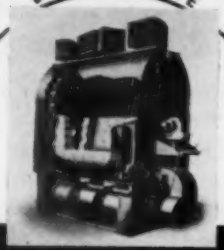

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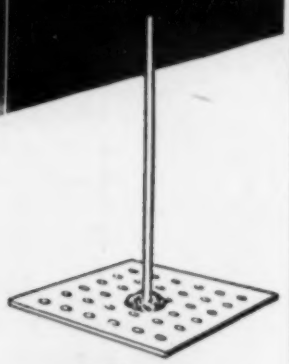

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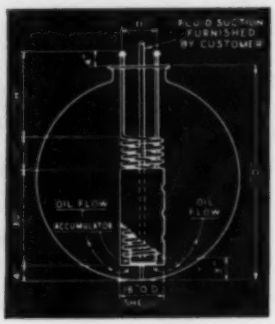

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apolis-Honeywell Regulator Co., 2604 4th Ave., S., Minneapolis 8, it also covers a number of the firm's control systems.

No. 7360: Indicating Gages—A new four page brochure describing and illustrating "Superbronze" noncorrosive indicating gages is now available from Star Brass Div., Williams & Hussey Machine Co., Wilton, N. H. Types, ranges, construction details, and recent improvements are described.

No. 7361: Intake Filters—Dollinger Corp., 56 Centre Pk., Rochester 3, N.Y., has issued a four page folder on its line of dry type intake filters featuring radial fin construction. Various models are illustrated and capacities range up to 8000 cfm. Several installations in connection with compressor intakes are shown.

No. 7362: Large Induction Motors—A special 32 page issue of the house organ published by Electric Machinery Mfg. Co., Minneapolis 13, deals with basic theory, operation, characteristics, control and applications of the company's units. Covering both squirrel cage and wound rotor motors, the booklet has almost 50 graphs and explanatory figures.

No. 7363: Low Pressure Commercial Steel Boilers—Catalog 507 of National Radiator Co., Johnstown, Pa., covers 16 sizes having SBI net ratings from 2500 to 35,000 sq ft of steam radiation. Boilers are of the three pass, rear smoke outlet type. Detailed information is given on units designed for use with hand, stoker, or oil firing.

No. 7364: Low Temperature Brazing—A number of applications for "Easy-Flo" and "Sil-Fos" low temperature brazing alloys are illustrated in the No. 47 issue of the house organ published by Handy & Harman, 82 Fulton St., New York 7. The fabrication of copper tanks is featured.

No. 7365: Making Steel—In simple, nontechnical terms the manufacture of steel in the United States, from raw materials through finished products, is described in a 100 page booklet prepared by United States Steel Corp., 71 Broadway, New York 6. Entitled Steel Making in America, it was prepared primarily for school students but is available to others. A brief history of the iron and steel industry is also included.

No. 7366: Materials of Construction for Flowmeters—Fischer & Porter Co., 97 County Line Rd., Hatboro, Pa., has issued a bulletin listing construction and packing materials for its "Flowrator" instruments. Corrosion resistant materials tabulated are for use with over 300 industrial liquids and gases.

No. 7367: Metallizing to Prevent Corrosion—How the application of zinc or aluminum prevents corrosion and extends the life of equipment is told in Bulletin 62 of Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N.Y. Applications shown include storage tanks, degreasing tanks, refrigerator cold plates, fan wheels, filter beds, and structural steel.

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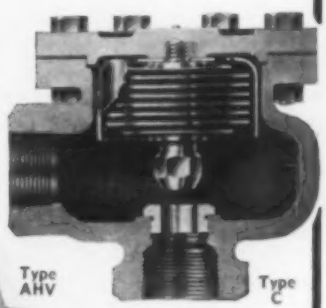

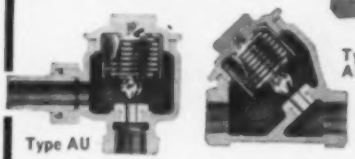

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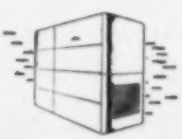

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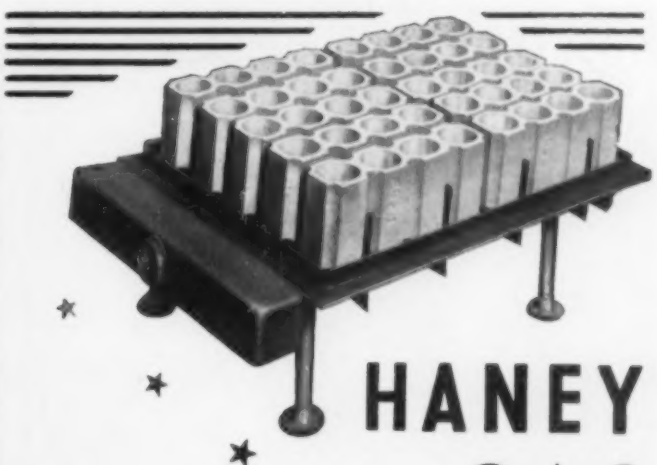

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No. 7368: Miniature Variable Ratio Speed Changer—A single page bulletin (No. 99) covers the operating principle, applications, and design features. Dimensional drawings and characteristic curves are included. It is offered by Metron Instrument Co., 432 Lincoln St., Denver 9, and has a nominal maximum horsepower output of 0.025.

No. 7369: Motors, Gear Reducers, Bases, and Fans—The complete line available from Electric Motor Corp., Div. of Howard Industries, Inc., Racine, Wis., is concisely described in a four page illustrated catalog. Compactness and ready accessibility of information are said to make the folder especially useful. The motors described are of two types, brush and shaded pole. Horsepowers range from 1/2000 up to ½.

No. 7370: Packaged Air Conditioners, Ammonia Product Coolers—Rated at 7.9 tons, the series RCY-200 package conditioner of Worthington Pump and Machinery Corp., Harrison, N.J., is designed essentially for installation remote from the conditioned space. Pertinent data are given in a single sheet bulletin, C-1100-S73. The series UCY vertical floor mounted, ammonia product coolers of the dry type are covered in leaflet C-1100-S74. Units are offered in five sizes from 2 to 20 tons and may be used for temperatures above or below freezing.

No. 7371: Portable Electric Tools—The new "Thor" line offered by Independent Pneumatic Tool Co., Aurora, Ill., includes impact wrenches, drills, grinders, polishers, and saws. Units are briefly described and list prices are given in a new four page folder, No. JE-1063.

No. 7372: Propeller Fans for Large Area Applications—The air circulators of Emerson Electric Mfg. Co., St. Louis 21, Mo., are recommended for all types of buildings where there is need for moving air over large areas, such as in retail shops and stores, restaurants, hotels, recreation buildings, industrial plants, etc. Bulletin X6258 covers the complete line and gives suggestions on selection and installation.

No. 7373: Protective Coating—"Totrust," a rust inhibitive paint primer and finish coat combined, has been improved to give deeper penetration, high gloss, and tougher weathering. It is available in a variety of colors and is described in a folder issued by Wilbur & Williams Co., Greenleaf and Leon Sts., Boston 15.

No. 7374: Purger for Refrigeration Systems—How air and other noncondensables get into refrigeration systems, the adverse effect this has, and what the company's forged steel purger does to prevent it is the subject of a new eight page bulletin (No. 192) released by Armstrong Machine Works, Three Rivers, Mich. Installation data, specifications, and prices are given.

No. 7375: Refrigerant Dryers—The feature article in the Vol. 13, No. 4 issue of the house organ published by Ansul Chemical Co., Marinette, Wis., is part four in a series by Walter O. Walker, director of research, and is a review of refrigerant dryers. Topics covered include size of the unit, dryer particle size, low temperature drying, removal of acids, and colored leak indicators.

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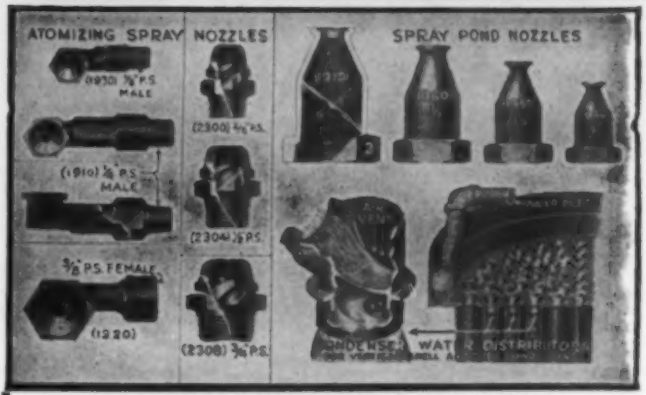

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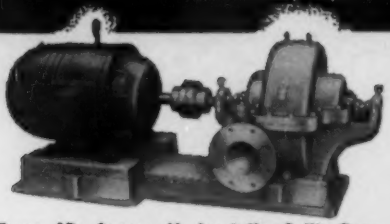

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No. 7376: Refrigeration Compressors and Condensing Units—An eight page chart in Bulletin 204-5 lists the complete line of units available from Mills Industries, Inc., 4100 Fullerton Ave., Chicago 39. Specifications and pertinent data are given on air cooled units from ¼ to 3 hp, water cooled units from ⅓ to 10 hp, and combination air and water cooled from ½ to 3 hp.

No. 7377: Refrigeration Condensers—Acme Industries, Inc., Jackson, Mich., has issued two new bulletins on its line of condensers. Each contains detailed information on design and construction features, dimensions, ratings, and the recommended selection method. Catalog No. 527-A covers evaporative units for both "Freon" and ammonia in sizes from 10 to 100 tons. "Freon" condensers of the shell and tube type are described in Catalog No. 23-B. A wide range of sizes are offered.

No. 7378: Refrigeration Specialties—The new catalog, No. 99, of Henry Valve Co., 3215 North Ave., Melrose Park, Ill., includes, in addition to many new items, products previously listed in Catalog 98 and its ammonia valve supplement. New products include "Blue Bantam" packless valves, flanged globe valves, relief valves, dryers, filters, and check valves, together with flange unions and compressor valves. Also included is information on the selection of relief valves, and a comparison of special and current dryer cartridge catalog numbers. A new discount sheet and trade net price schedule have been issued recently.

No. 7379: Resistance Thermometer—The new "Resitherm" is a portable, thermometric slide wire bridge unit designed for temperature readings of 0.5 or 0.1 deg. It is said to measure the temperature of liquids, gases, and melting metals and is offered in a number of types with temperature ranges up to 2300 F. Construction and operating features are given in a leaflet issued by Paul G. Weiller, 95 Broad St., New York 4.

No. 7380: Self Priming Centrifugal Pumps, Vertical Turbine Pumps—Powered by air cooled gasoline engines, the self priming centrifugal pumps of Worthington Pump and Machinery Corp., Harrison, N.J., are briefly described in Bulletin W-395-B1. They are designed to operate at suction lifts up to 25 ft and are available in a variety of sizes and mountings with capacities up to 700 gpm. Vertical turbine pumps in sizes from 6 to 14 in. having capacities from 50 to 3000 gpm are covered in two new bulletins. The oil lubricated models are described in Bulletin H-450-B35 and the water lubricated units are featured in Bulletin H-450-B34.

No. 7381: Silicone Greases for Ball Bearings—Dow Corning Corp., Midland, Mich., has released two new publications. Silicone Notes No. D-5 gives the properties, performance, and uses of these lubricants. A variety of test data are included. Silicone Notes No. D-6 contains information on how to use DC 44 grease in the bearings of electric motors and includes instructions for lubricating open and single shielded ball bearings, together with relubrication schedules. Use of double shielded and cartridge type ball bearings prelubricated for life is also discussed.

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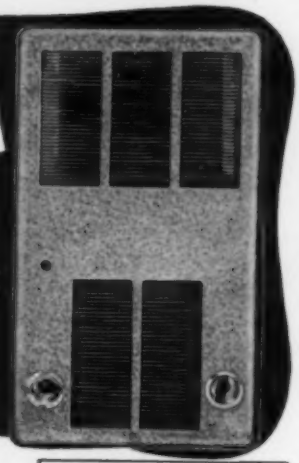

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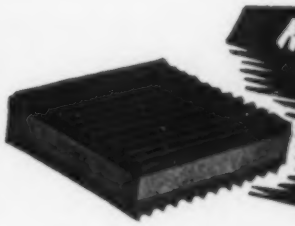

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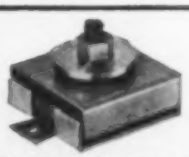

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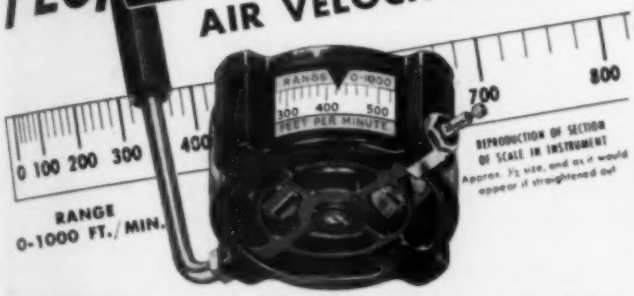

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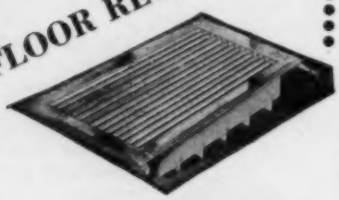
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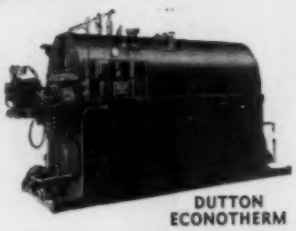
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No. 7382: Stainless Steel Gate Valves—The advantages in design and construction of the 2 in. valves offered by Cooper Alloy Foundry Co., Bloy St. & Ramsey Ave., Hillside, N. J., are set forth in a new comparison chart. Cross sectional drawings are used and three competitive valves are discussed.

No. 7383: Synthetic Lubricants—Information on applications together with complete physical properties of both water soluble and water insoluble grades of "Ucon" polyalkylene glycol lubricants are given in a 28 page booklet (Form 6500) of Carbide and Carbon Chemicals Corp., Unit of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17. Uses are said to include lubrication of many types of machinery, gears, internal combustion engines, rubber products, and instruments. Data are also given on uses as hydraulic fluids, leather conditioning agents, plasticizers, softeners, solvents, defoamers, de-emulsifiers, and heat transfer fluids.

No. 7384: Timing Devices—The 1949 line of "Mark-Time" switches and timer devices is illustrated in a new six page condensed catalog issued by M. H. Rhodes, Inc., 30 Bartholomew Ave., Hartford, Conn. Descriptions of each unit are given and special features and accessories are covered.

No. 7385: Turbine Pumps—Units for "every water transfer job in the wide ramification of industrial operations" are said to be the theme of two new booklets issued by Johnston Pump Co., 2324 E. 49th St., Los Angeles 11. The text deals with applications, design and construction features, and interchangeability of parts. Bulletin 1013 covers oil lubricated pumps and Bulletin 1014 deals with water lubricated units. Sizes of these vertical type units range from 4 to 18 in., 2 to 500 hp, for lifts up to 600 ft, with capacities from 15 to 4000 gpm.

No. 7386: Welding Accessories—Air Reduction Sales Co., 60 E. 42nd St., New York 17, has released a 15 page catalog on oxyacetylene and electric arc welding accessories, including goggles, hose, spark lighters, gloves, electrode holders, cable, cleaning tools, helmets, face shields, etc.

No. 7387: Wound Rotor Motors—From 1 to 150 hp at 1800 rpm (and proportional horsepowers at lower synchronous speeds) are covered in Bulletin SR-1 issued by Howell Electric Motors Co., Howell, Mich. Specifications, dimensions, and performance characteristics of these slip ring motors are given.

Simplifies Listing of Dimensions, Weights, Tolerances for Copper and Brass Pipe

Simplified Practice Recommendation R217-49, Copper Water Tube and Copper and Brass Pipe, consists of a simplified list of types and sizes and gives dimensions and weights for 18 sizes, as well as dimensional tolerances and recommended uses.

The recommendation has been issued by the Commodity Standards Division, National Bureau of Standards, and printed copies are available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. for 10 cents each. A discount of 25 percent is allowed on orders for 100 or more copies.

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